An investigation into the impact of flipped learning homework tasks on pupil motivation in science education.

ABSTRACT

Homework is almost universally set and yet for some pupils it can be demotivating. In this study I aim to see whether the use of flipped learning (Bergman & Sams, 2012) homework tasks can serve to increase motivation. Over the course of a term, in two sets of year 12 biology, Kahn Academy videos were used to deliver 2 cycles of action research. Pupils were asked to watch videos and simultaneously make notes; in the following lesson they completed tasks to help consolidate their learning. Motivation was measured using the Science Motivation Questionnaire II (Glynn *et* al., 2011) and focus group interviews. The SMQII is designed to measure 5 aspects of motivation: intrinsic motivation; self-efficacy; self determination; grade motivation and career motivation.

The results of the study were notably different for the two sets. The SMQII results showed that flipped learning increased the motivation levels of the higher attaining set and decreased motivation in the other, lower ability, class. Interview data demonstrates the value of flipped learning in increasing self-efficacy and self-regulation in some pupils, but it is challenging and demotivating to others. It is evident from this study that for flipped learning to be effective, it is crucial that pupils are supported with appropriate resources. This evidence has helped to inform a review of homework in my secondary school and flipped learning will be employed in the biology department next year.

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1. INTRODUCTION

As yet another school announces that it is abolishing homework for the benefit of teachers and to increase their time to plan lessons, homework is once again a topic of debate (Pells, 2016). For many years homework has been considered a conventional facet of schooling (Kidwell, 2004, Cooper, Robinson & Patall, 2006, Stern, 2006). Given that many schools are now reconsidering its value (Paton, 2013) and some schools are even abandoning it altogether, it is a convention which warrants further discussion. I fully agree with Julian Stern (1997, 2006) who believes that schools need to think carefully about the work they set:

> I am not an abolitionist. But schools have to think carefully about why, exactly, they set homework, and if they don't tackle this deep issue, they are unlikely to gain agreement from teachers, pupils and families about what homework to set. (Stern, 1997: 3)

It is all too easy to question the value of homework, but as a teacher I think the challenge should be to set homework which is stimulating and beneficial. Pupils spend hours each week completing homework and therefore as teachers we should feel compelled to make sure this time is well used. I am choosing to look at pupil motivation as I observe that those who are motivated seem to exceed the expectations teachers may have of them. Considering how to make homework beneficial is an area I have previously considered (Lyon Taylor, 2016) and I shall revisit some of these areas. In my role in a secondary school I am always curious as to what motivates pupils and whether I can influence this motivation by my teaching strategies. More specifically, this study will consider whether the homework which pupils are set can actually serve to motivate pupils. If this intervention can influence motivation then I believe it is of great benefit to me as a teacher, my pupils and colleagues.

To start, it is critical to highlight what homework is, and therefore a clear definition is useful. Farrell & Danby (2015) define homework as: 'school-prescribed tasks undertaken by children and usually under the supervision of an adult, most often parent/parents within the home' (Farrell & Danby, 2015: 250).

Cooper (1989, 1992, 2006, 2007) of Dukes University, has carried out much research into homework and agrees that homework is 'tasks assigned to students by school teachers that are meant to be carried out during non-school hours' (Cooper, 1989: 86). Further research into homework in the U.K. has been carried out by Kidwell (2006) and Stern (1997, 2006) and they both agree with Cooper's definition given above.

When considering current practices a historical perspective is informative. Perhaps surprisingly homework as a practice is older than one might think with the first reference to its use being in the 11th century. An Italian teacher Roberto Nevillis asked students to use the time in between lessons to research topics beyond the classroom between lessons (Farrell and Danby, 2015). As I will later introduce the concept of flipped learning, it is worth drawing a parallel at this stage between this earliest use of homework and the principles of flipped learning. In asking pupils to research outside the lessons and arrive ready to discuss these topics, Nevillis was practising an early form of flipped learning. Also many parallels can be drawn with our current need to extend pupils beyond the classroom, both with a view to developing their independence of study and also the number of hours of study.

Having investigated the views of pupils and staff in my current school (school x) last year, I am interested to consider more explicitly the nature of the tasks which pupils are set for homework. I summarised in my research last year that homework served three purposes:

1 - Consolidate knowledge

2 - Improve attainment

3 - Motivate pupils (Lyon Taylor, 2016)

I found few studies which have looked at the efficacy of different homework tasks and after considering different styles of homework tasks I have decided to implement an intervention specifically investigating flipped learning. Gill and Schlossman (2004) feel that there is not enough evidence to support the value of homework. Although this is philosophically an interesting consideration, I have chosen to focus on trying to make the homework tasks practitioners set as useful as possible in the knowledge that having been used by educators since the 11th century, it is likely to

remain. This said, the school in which I work is reviewing effective setting of homework, so my research will feed into this study and this will allow me to collaborate with colleagues. Having discussed the principles of flipped learning with two colleagues in the science department who feel that they use it effectively, I have decided to explore the impact this may have on pupil motivation.

I work in a large co-educational independent school with circa 950 pupils. As the school is a boarding school, homework is carried out in pupils' own bedsits in the evening between 1930 and 2100. As I supervise this period each evening I often wonder about the quality of the work the pupils complete and also the benefit of many of the tasks they are set. Some tasks seem to be used to keep pupils busy rather than serving a genuine educational purpose. With this in mind the school is currently considering the tasks which are set and how long pupils are expected to spend working independently each day; my research from last year has formed the foundation of this working party. Furthermore, in my research I will collaborate with colleagues to inform a whole school policy for the coming year. The rationale behind this study is to alter the homework strategy in my own teaching and see if this has an impact on pupil motivation. I will discuss this with colleagues and feedback into Mutual Observation Groups (MOGs); these are small groups where we discuss professional practice. The groups are led by a MOG leader and the research I completed last year formed the basis of their first meeting in September 2016. I will also feedback to the director of teaching and learning at regular intervals throughout my study.

2. LITERATURE REVIEW

I have structured my review of current literature to first consider the foundations of motivation and then to dissect the facets which contribute to this complex process. Having expanded on the areas which contribute most to motivation of secondary school pupils, I will look at how motivation can be influenced and then more specifically how homework tasks can influence motivation. Finally, with the flipped learning intervention in mind, I will finish by considering how flipped learning can influence motivation.

WHAT IS MOTIVATION?

The term motivation comes from the Latin verb, movere which means 'to move' and so as a starting point it refers to the ability to keep moving forward (Schunk, Mecce & Pintrich, 2014). In a 'Handbook of Human Motivation' Ryan (2012) discusses the complexities of human behaviour and emphasises that humans are motivated, goal-orientated, creatures. The field of human motivation is being more intensively studied than ever before. In spite of the extensive research and theories constructed, as Galloway *et al.* (2004) emphasise, motivation is an elusive concept. Motivation is not easy to measure and there is not a single value which can be used to record it. This makes it difficult to measure and most certainly it is multi-faceted (Smith & Spurling, 2001).

Motivation is defined as being 'an internal state that arouses, directs and sustains goal-oriented behaviour.' Motivation to learn science is further defined as 'an internal state that arouses, directs, and sustains science-learning behaviour' (Glynn, Brickman, Armstrong, & Taasoobshirazi, 2011)

Schunk and Meece (2008) go further and elaborate in recognising that motivated students achieve academically by engaging in question asking, advice seeking, studying and participating in classes, labs. and study groups. They define motivation more simply as 'Motivation is the process whereby goal-directed activities are instigated and sustained.' (Schunk, Mecce & Pintrich, 2014)

Palmer (2005) highlights that motivation is an integral factor in the construction of knowledge and therefore as teachers we should always be looking to influence and nurture motivation. Deci and Ryan (1985) have carried out much research into the nature of motivation and looking at why the behaviours we observe in learners exist. In my practice in a secondary school it is these characteristics which I recognise as being critical in enabling pupils to reach their potential. Many teachers recognise that the student who does not reach their potential often lacks the motivation needed to help them sustain their efforts.

Before moving on to consider how motivation of learners can be affected, I will review the motivational theories which exist. As Smith *et al.* (2005) also acknowledge, motivation is complex and therefore so is the deciphering of literature. I recognise that I will not cover the full spectrum of theories which exist; some are more related to psychology, and so I do not feel they have direct relevance or application in science education. Motivation is a multi-component construct but I will focus on four areas:

Behavioural Theories

Drive Theories

Extrinsic Motivation

Intrinsic Motivation

1 - Behavioural Theories

Behaviour theories became more common in the U.S. at the start of the 20th century and three were particularly prominent:

- Connectionism - this relates to trial and error learning mechanisms which lead to connections.
- Classical Conditioning - In his well-known experiments Pavlov conducted experiments to link or associate two unconnected stimuli. Many teaching methods employ this technique; giving young children rewards or stickers after having done something good is an example of this. Deci, Koestler and Ryan (2001) have conducted research which argues that students who are rewarded in this way will suffer from reduced intrinsic motivation. A review conducted by the motivational review group

at the University of London, Smith *et al.* (2005) highlight how the practice of giving rewards promotes a more passive approach from pupils which does not sustain motivation. Kohn (1993) goes further in suggesting that this approach will actually curtail creative opportunities and that it will decrease intrinsic motivation. Although his book can be applied to education it is written with a view to application in the workplace, so this suggests that we should be cautious in applying this too stringently. In contrast however, Cameron (2001) fervently argues against these views and more specifically those held by Deci, Koestler and Ryan and so contention exists. The classical conditioning principles of Pavlov are less controversial, until put into an educational context.

- Operant Conditioning - Skinner (1953) developed experiments which required rats to perform an action in order to gain a reward. His apparatus known as Skinner's box had a lever for rats to pull in order for food to be dispatched. The food is an example of positive reinforcement which will increase the likelihood of a response in the future. A negative reinforcer could also be used to decrease the likelihood of a response in the future. As with classical conditioning both positive and negative reinforcement is used in teaching methodology. Many school sanctions work as a negative reinforcement technique. Whether this leads to the pupil being more likely to complete work more thoroughly or be more motivated next time is something to consider.

All of these theories view motivation as a behavioural response to different stimuli. These theories suggest motivation is observable and could be said to ignore any intrinsic/non-observable affects which might relate to individual qualities of the rats (or other subjects being investigated).

By contrast chronologically, cognitive theories followed as the understanding of the brain developed. These theories placed greater emphasis on internal/mental processes. The complexities of human motivation do not allow such a simple application of behaviour theories to predict pupils' responses and I will consider this further under sections three and four below, particularly in the intrinsic motivation section.

2 - Drive Theories

Chronologically following on from behavioural theories, further theories on motivation were formulated by Hull (1943) and called systematic behaviour theory. These distinguished between drive and learning and were thus often termed as Drive Theories. Deci and Ryan (1985) recognise that for many years, although different methods were used in research, their focus came down to drive. Hull (1943) elaborated on Freud's early theories in which he highlighted two basic drives: sex and aggression. Hull went on to suggest that there are four: hunger, thirst, sex and the avoidance of pain (Hull, 1943, Deci & Ryan, 1985). He stated that it is what he termed drive which accounted for the intensity and duration of a behaviour. This theory perhaps could be seen to reflect a more traditional viewpoint in that it detached learning from drive. Teachers were seen as able to influence the learning of pupils but not their drive and perhaps conveniently this allowed for teachers to disown any responsibility for the pupils' drive. Hull also suggested that amount of reward was critical for learning so that when a large reward was given straight after attaining a goal it strengthened the learning; if reward size decreased so did the learning response. Although this is rather intuitively neat it was not supported by research, in particular by Honzik's experiments using rats which showed they learned irrespective of reward (Schunk, Mecce and Pintrich, 2014).

As much of Hull's research involved the use of animals Mowrer was then the first to consider human emotions in consideration of motivation. He realised that emotions can interfere with the simple relationship of stimulus and response and started to consider the impact of more complex factors. In considering these we must recognise that the weakness of the behaviouralist theories is that they suggest that motivation can be predicted (Galloway, *et al.* 2004). Arousal theories build on the link made by Mowrer and are much less behavioural and more cognitive. The principles are that optimum arousal will serve to motivate, linking the impact of homeostasis on levels of motivation and thus involving the brain.

Social Cognitive Theories

Having considered the development of early behavioural theories and drive theories I will now consider social cognitive theories. Social cognition focuses on how people acquire knowledge, rules, skills, strategies, beliefs and emotions and that behaviour is an interaction of the individual with the environment. Bandura's (1982) social cognitive theory brings together personal factors, behaviours and environmental influences and is therefore more complete than many of the earlier theories as it is more multifaceted. Social cognitive theory explains human learning and motivation by complex interactions involving personal characteristics - intrinsic motivation, self-efficacy, and self-determination. These directly link to the previous definition of motivation as an 'internal state that arouses, directs and sustains goal orientated behaviour.' More recent theories have stemmed from better understanding of neuroscience. There are areas of the brain associated with goals, rewards, attributions and self-efficacy and therefore these have informed more recent theories. Social cognitive theory includes intrinsic and extrinsic motivation but relates to the students' belief and understanding about themselves and their own learning (Palmer, 2005). Pintrich and Schunk (1996) elaborate further by highlighting that the social cognitive view is that the classroom context can influence motivation hence is extremely relevant here and forms the foundations of the Science Motivation Questionnaire II (Glynn *et al.,* 2011) which I will be using in this study.

In research for the university of London, Smith *et al.* (2005) review the factors affecting the motivation of pupils aged 11-16 in the U.K. so is particularly relevant to my study. They consider whether the delineation of motivation into extrinsic and intrinsic is appropriate. They suggest that motivation is a combination of both intrinsic and extrinsic factors. Using these simple categorisations one could suggest that behaviourist theories discussed above could be considered to be extrinsic, and drive theories more intrinsic in orientation. This classification will become more clear as I expand on these two areas below.

3 - Extrinsic Motivation

Extrinsic motivation is the motivation to engage in an activity as a means to an end (Schunk, Pintrich & Mecce, 2014). It can be considered as goal orientated behaviour (Smith & Spurling, 2001) in which pupils are motivated to succeed because of the prospect of a favourable end result. Working in a secondary school where the focus on GCSE and A level grades is prominent I would expect these results to strongly influence motivation. Extrinsic motivation can be split into two: grade motivation (short term) and career motivation (long term). As defined above by Ryan and Deci (2000) extrinsic motivation has a separable outcome. As I have mentioned above this technique is commonly used in the classroom in ways such as rewards and privileges. Further work by Deci, Koestler and Ryan (2001) has questioned the effectiveness of this strategy in developing motivation. The year 12 pupils involved in the study are very conscious of likely A level grades and for many this is a motivating factor. Pajares (2002) looked at gender differences in self-efficacy and in doing so highlighted the importance of goal-setting in helping develop motivation. Mecce, Glienke, and Burg (2006) also conducted a study looking at gender and motivation. They found that boys were more inclined to be motivated in maths and science but that girls were more motivated in arts and writing, thus illustrating the cross over between extrinsic and intrinsic motivation. Of great relevance to this study and the principles I will be discussing about homework and flipped learning, Deci and Ryan (2000) highlight the importance of encouraging pupils to be active and engaged in their learning. They suggest that this helps to increase motivation and counter the less stimulating classroom tasks. I think that this view is directly relevant to the flipped learning homework tasks I will explore in later sections.

4 - Intrinsic Motivation

Finally, by way of contrast to extrinsic motivation, which is concerned with motivation for external 'reward', intrinsic motivation is concerned with motivation for its own sake. The theory of intrinsic motivation was formalised by White in 1959. As with Freud and Hull, White approached the subject from a psychological background but he felt that something was being ignored, something he referred

to as 'competence'. More recently, Ryan and Deci (2000) defined Intrinsic and Extrinsic Motivation as follows:

> Intrinsic motivation … refers to doing something because it is inherently interesting or enjoyable, and extrinsic motivation … refers to doing something because it has a separable outcome. (Ryan and Deci, 2000: 55)

The theory of intrinsic motivation revolves around the idea that learning generates feelings of confidence and mastery that are self-reinforcing and the pupil is therefore more likely to engage in future learning activities for the enjoyment of succeeding (Palmer, 2005). Intrinsic motivation is motivation to engage in an activity for its own sake (Schunk, Pintrich & Mecce, 2014). Intrinsic motivation attributes personal relevance to the learning scenarios. It involves the feeling of inherent satisfaction in learning science for its own sake (Black and Deci, 2000). Palmer (2005) suggests that intrinsic motivation is therefore directly related to the type of task performed. Based upon this statement by Palmer I would therefore expect this to be strongly affected by the nature of homework activities set.

Harter produced the theory of mastery orientation (Galloway *et al.* 2004). As Palmer (2005) highlights, intrinsic motivation involves deriding satisfaction from the mastery of the topic. Within the category of intrinsic motivation, other theories have been developed. One of these is that of mastery orientation which is very much in line with Carol Dweck's (1986) theory of growth mindsets. She suggests that learners can hold one of two mindsets: either they are 'entity' or they are 'incremental'. Those with an 'entity' belief will feel that their intelligence is fixed and this influences the way they view failures. The 'incremental theorists' will view intelligence as something they can cultivate and thus failures will be viewed as a result of a lack of effort (Smith *et al.* 2005). These principles directly feed into the theory of mastery orientation which is concerned with the desire to achieve mastery of the subject, coupled with realistic levels of self-esteem. In contrast to extrinsic motivation however, pupils are not looking for external 'reward' for their mastery of the subject. Failure does not imply a lack of ability but that pupils should be motivated to work harder in order to achieve success. The theory looked at both success and failures. Harter suggested that mastery orientation revolves around the desire to be challenged and for an individual to master and challenge and therefore feel internally successful (Galloway *et al.,* 2004).

Another branch of intrinsic motivation which was developed by Weiner in the 1960s is attribution theory (Weiner, 1986 & 1992). The theory assumes that pupils develop as learners from different scenarios and see these as a benefit, they attribute successes to their effort and in turn this serves to motivate. Smith *et al.* (2005) suggest that a learner who is mastery orientated will actually be highly motivated by failure, this will increase their motivation for their next task in order that they may achieve mastery and meet with success. Coutts (2005) and Warton (2001) in research into homework recognise that pupils see short term goals and I will discuss these concepts more when considering research into homework.

Another area of intrinsic motivation which is crucial when considering homework tasks is the belief of pupils that they can perform a given task: this is known as self-efficacy. Self-efficacy relates to the belief pupils have about their ability to perform at certain levels and it can be linked to the principle of self-regulation. Higher levels of self-efficacy a have been found to indicate higher levels of motivation (Wigfield *et al.,* 2006). Martin (2002 & 2007) constructed a multi-dimensional model of motivation. His research was carried out in 38 high schools in Australia and he found that motivation increased levels of self-efficacy. Plenty and Heubeck (2011) conducted further research in mathematic lessons in Australian high schools. They used Martin's (2007) broad model of motivation and found that academic achievement was largely influenced by motivation and engagement in the learning process. Research shows pupils who feel self-efficacious will expend more effort in order to learn and persist at difficult tasks, they will thus show greater motivation (Schunk and Pajares, 2009, *cited in* Schunk, Mecce and Pintrich 2014). Figure 1 below shows the results of Hong *et al.* (2015) study into the effect of various factors on homework performance. The digram shows that those who showed higher levels of self-efficacy showed improved homework performance and also showed lower levels of worry. Their study was carried out in Maths and English in 10th grade pupils in Hong Kong. Bandura and Locke (2003) further extol the virtues of self-efficacy which directly relates to figure one below in reducing worry and increasing the perceived value of homework.

> Among the mechanisms of human agency, none is more central or pervasive than beliefs of personal efficacy. Whatever other factors serve as guides and motivators, they are rooted in the core belief that one has the power to produce desired effects; other on has little incentive to act or to persevere in the face of difficulties. (Bandura & Locke, 2003: 87)

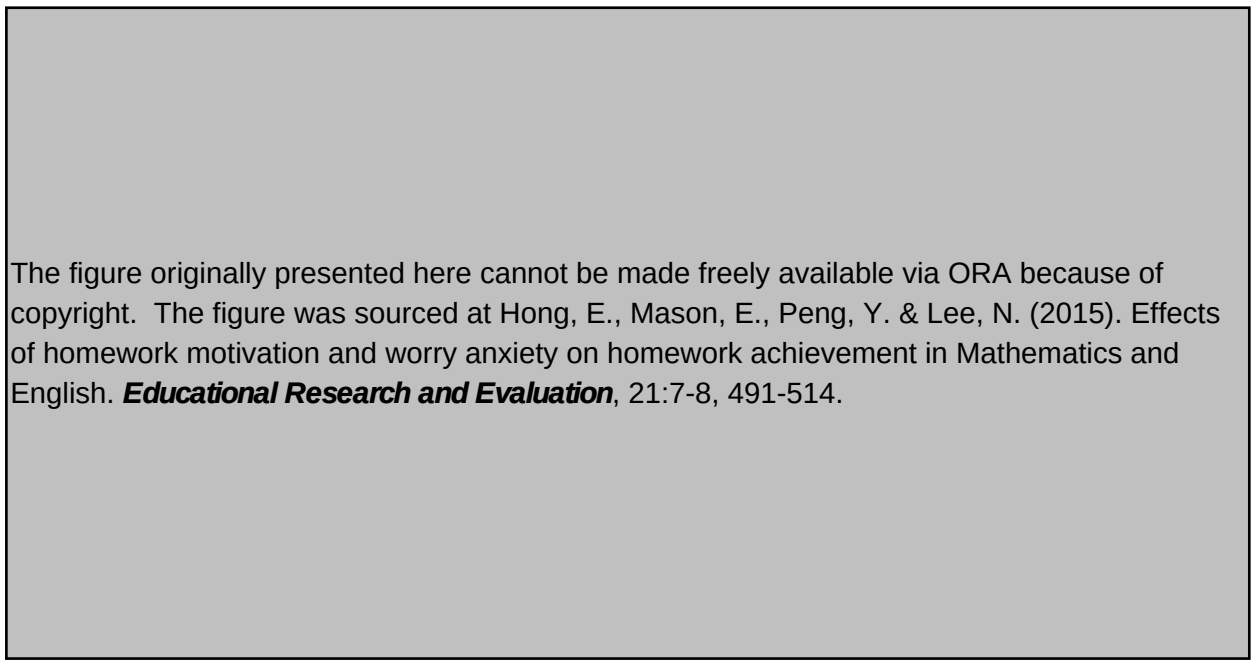


*Figure 1. The final structural model with standardised path coefficients. +p < .10. *p < .05. **p <.01. ***p < 001. NS = Not significant. (Hong et al. 2015: 496)*

Bryan, Glynn and Kittleson (2011) looked at what motivates 14-16 year olds to learn in U.S. high school science lessons. The study is of direct relevance here as the pupils responded to questionnaires looking at self-determination, self-efficacy and intrinsic motivation, the same areas to the questionnaire I will use. They looked to study the interactions between intrinsic motivation, self-efficacy and self-determination and found that self-efficacy was the most important component of motivation when comparing achievement. The findings of this study also suggest that teachers should use collaborative activities and social-modelling to help increase motivation. The study raises another area relating to motivation, that of self-determination. Self-determination theory (SDT) is a theory put forward by Deci & Ryan (1985, 2002) that links both self-efficacy and self-determination. Self-determination in an educational context recognises that 'motivated actions are self-determined to the extent that they are engaged in wholly volitionally and endorsed by one's sense of self' (Deci & Ryan, 1991). Self-determination is borne out of intrinsically motivated behaviours and therefore it is not possible to divorce the two neatly. Self-determination recognises the importance of pupils feeling interested in their learning and a confidence in their own capacity and ability to learn (Deci, Vallerand, Pelletier & Ryan, 1991). This interest and involvement in their learning highlighted by the

SDT is the essence of what I hope that pupils will strive to achieve. SDT is not applicable when an individual is working for a reward or extrinsic goal. Deci *et al.* (1991) highlight quite simply that that SDT relies upon competence, relatedness and autonomy. This theory chimes with what I hope for my pupils, most especially in the sixth form and I am curious to see if SDT is something which is engendered by the flipped learning intervention. Deci *et al.* (1991) found that greater pupil choice and responsibility helped to enable self-determination and promote active motivation. The theory of self-determination is investigated practically by Schumm and Bogner (2016) who looked at 232 tenth grade students and used the Science Motivation Questionnaire II (which I will also be using) to measure self efficacy and self-determination. They found that girls had a higher perceived self-determination but lower self-efficacy than boys. This study will allow for useful comparison with my own results.

In summary, there is vast amounts of literature on motivation. I have reviewed the many theories which I feel are most relevant to education. I recognise that there are 5 main groups which I will return to in this study: extrinsic in the form of short term, grade motivation and long term, career motivation; intrinsic motivation which can be split into self-determination and self-efficacy. I will now consider how motivation can be increased before then considering how homework and flipped learning can influence motivation.

WHAT ARE THE WAYS OF IMPROVING MOTIVATION?

As I have discussed, motivation is multifaceted. I have highlighted that of most relevance to this study are the areas of grade motivation, career motivation, intrinsic motivation, self-efficacy and self-determination. As a useful starting point, Smith *et al.* (2005) present the following points as important for increasing motivation: lessons are fun; lessons are varied and participative; teachers use collaborative methods and that pupils perceive activities as useful and authentic.

Lepper and Hodell (1989) suggested that intrinsic motivation can be enhanced by providing challenge, curiosity, fantasy and control. Challenge is an interesting word to use as it assumes that there must be a level of moderate difficulty in order that the pupils develop a sense of mastery when they succeed. If the task is too challenging though, some pupils with lower motivation may become despondent. Curiosity relates to the setting of novel tasks which can help develop intrinsic motivation. Another way which Palmer (2005) highlights is that of control. When pupils are in control it helps to increase feelings of autonomy and they are more likely to be motivated. I will refer to both of these aspects later in regard to flipped learning. Black and Deci (2000) looked at pupils in chemistry lessons and noted when they had feelings of self-determination they were more likely to perform better. Zusho, Pintrich and Coppola (2003) further discuss the role of self-regulation. They highlight the importance of self-regulation as an active constructive process whereby pupils set goals for their learning and monitor, regulate and control their cognition, motivation and behaviour constrained by their goals and contextual features of the environment.

Most significantly though, Pintrich (2004) furthered the concept of 'self-regulated learning' (SRL) and makes note of pupil motivation. SRL can be linked closely to self-efficacy as it demonstrates the same awareness of their role as learners. Development of SRL will therefore increase self-efficacy.

Schumm and Bogner (2016) recently conducted a survey using the Science Motivation Questionnaire II which I will be using. They looked at whether a short three lesson unit in science lessons at a school in Germany could influence motivation. They found that students measured to be more motivated performed better in tests. This may seem obvious but the challenge of this study is to see if I can manipulate motivation and in so doing help the pupils develop as better learners.

HOW CAN MOTIVATION BE IMPROVED THROUGH HOMEWORK?

Having considered some strategies to improve motivation, I will now focus more specifically on how homework can serve to motivate pupils. For many pupils homework occurs at the end of the day and the idea of having to sit down to work can be de-motivating. The dearth of research evidence I have found in this area helped me to narrow my research question and consider whether the tasks set for homework can actually help to increase motivation.

My previous point is supported by research by Sharp, Keys and Benefield (2011) who found that there is a disappointing lack of evidence to show what actually 'works' in terms of homework assignments. This does not surprise me as in my experience different tasks seem to work well for different individuals and thus the need to vary tasks is crucial. There is much research into homework by Stern (1997, 2007) and he is one of few researchers who give clear pointers for classroom practitioners as to what a 'good' homework task should look like. He has written a guide (Stern, 2007) for teachers and parents which hopes to provide a useful and practical synopsis for both. Foremost on his list is that homework should be something which is enjoyable for pupils, followed by the fact that they know what they are doing and that the work is challenging, but not impossible.

Having looked at general principles of motivation and then how motivation can be improved, I will draw on my own research from last year to summarise how homework can help improve motivation. Iflazoglu and Hong (2012) in a study of high school pupils in Turkey report that pupils who are more motivated perform better in their homework. I hope to see whether the tasks set can actually help to make pupils more motivated. I work with pupils between age 13-18 with a great range of abilities. There are clearly so many factors which affect their success, and indeed many different ways of measuring this success. Homework task design is complex. In my research last year (Lyon Taylor, 2016) in school x I found that in spite of the fact that research says that tasks should be varied (Petty, 2006) and appropriate (Cooper, 1989, Hoover-Dempsey and Sandler, 1995) to the class, the pupils whom I surveyed were narrow in their preference for exam questions. This may be because I sampled year 11 who, at the time of the survey, were gearing up for their GCSE exams and therefore were very exam focused. Whilst GCSE and A level exams are a critical component of the secondary school years, I hope that they do not dominate. For this reason I have selected year 12 pupils who are without

the pressure of AS exams and therefore I hope will be less exam focused and more more receptive to different forms of homework. I will investigate whether teachers can make homework a motivating process.

The curiosity to which Lepper and Hodell (1989) refer is something which is highly relevant to homework. If homework tasks are novel then it will help promote intrinsic motivation. The pupils will often be excited, and motivated, by the new task they are performing. This is particularly relevant to a new concept, as Palmer (2005) highlights that a novel concept will serve to influence the pupil motivation. By contrast Corno (2000: 530) says: 'Generally homework is not supposed to be fun' but this must be challenge for us as teachers. If the pupils do not enjoy what they are doing outside the classroom then we cannot hope for it to be motivating. I therefore see motivation as utterly pivotal in education and this study aims to manipulate homework tasks to influence pupil motivation. Listening to Khan's TEDTalk (2011) one cannot fail to be inspired and I would hope that pupils would view it with similar excitement. My hope with flipped learning is that the novelty creates a wave of excitement for the pupils and this serves to motivate.

Lepper and Hodell (1989) would argue that curiosity is sparked by novel experiences, so perhaps the schooling system is at fault for repression which leads to dulling of enthusiasm. Corno (2000) suggests that the tasks set for homework are crucial in helping pupils to feel more motivated; they should not simply do homework so as to avoid punishment for non submission. Studies of pupil motivation (Atkinson, 1964, Weiner, 1986, 1992) discuss the influence of successes and failures and the impact which these have on pupil motivation. Accordingly, Cooper (1989) suggests that homework should not be marked or graded by the teacher as this will result in them becoming demotivated. It is more important that pupils are given instructional comments rather than a summative judgement of the homework task. My own research from last year contradicts this, as pupils said that they were demotivated when work was not marked with a grade (Lyon Taylor, 2016). Tarras (2001) and Galloway *et al.* (2004) go further in considering good feedback practices and Tarras agrees that marks should not be given immediately so that the pupils fully read comments rather than just focusing on a grade. Galloway *et al.* (2004) discuss good feedback principles highlighting that they must give the pupils a clear indication of how to improve in order to be formative and aid self-regulation. In a

literature review of independent learning Meyer *et al.* (2008) found that feedback on marking is vital in order not to demotivate pupils. When the teacher does not take interest in the work that the pupils produce the pupils are demotivated.

Furthermore, Meyer *et al.* (2008) suggest that scaffolding is key to support pupils in independent learning. Although some pupils can flourish in many given tasks, motivation can decrease if pupils do not feel self-efficacious. Scaffolding of homework tasks is therefore another useful way that teachers can try to encourage pupil motivation. In the same study they also found in the Netherlands that pupils who self-regulate are more motivated. If pupils can be encouraged to work better independently then they work to a higher standard. Homework is often completed independently as pupils are most often carrying out homework at home, or at the very least away from the classroom. In school x, as I will later explain, homework is completed in study bedsits in boarding houses so the points made by this study (Meyer *et al.,* 2008) are of direct relevance. In summary therefore, scaffolding is a key component, self regulated pupils have higher levels of motivation and independent learning helps to increase motivation.

Farrell and Danby (2015) approached the study of homework from a pupil's perspective, but they were looking at primary school aged children and focused more on the ability of the children to cope with the organisation of homework rather than the homework task itself. This links to Corno (2000) who feels that part of the homework process is preparing and teaching pupils to work outside the classroom. She highlights the benefits of collaboration between children in developing skills and also the importance of self-regulation in the homework process. So aside from the output in the form of the homework submissions, the process of working alone (and with the involvement of Virtual Learning Environments and blogs in many schools) and collaboratively outside the classroom has value in developing the pupils as more self sufficient and independent learners (Petty, 2006). The suggestion from these studies therefore is that collaborative homework tasks can help to increase motivation.

Another area to consider is the difference in preference between girls and boys. The idea of gender differences in homework has been investigated by Mecce, Glienke and Burg (2006) who found difference were more related to subjects rather than preferences of activity. They found that boys

preferred maths and science and girls, arts and writing subjects. More specifically to homework tasks, Iflazoglu and Hong (2012) observe gender differences in homework tasks. Boys benefit from homework which is parent motivated, to me this would seem to indicate a lack of motivation on the boy's behalf. Furthermore, they recognise that boys also seem to prefer homework which is more active. Overall, they also report that girls have a more positive outlook on homework. Hong and Milgram (2000) observed some boys preferring activities which are more kinaesthetic in nature, this supporting Iflazoglu and Hong's (2012) research. Overall though, they found that differences between genders were less pronounced than they might have expected.

Cooper's research (1999) in secondary school (aged 11-18) pupils states that pupils should aspire to spend at least 1.5 hours on homework each evening. In school x pupils have a regular 1.5 hour period assigned to homework to make it easier for pupils to know when to do their homework and hopefully carry it out more effectively when free from distraction. Clearly in order for pupils to remain motivated the role of the teacher is critical (Corno, 2000, Hattie, 2012) but the hope is that when flipped learning is employed it allows the teacher more time in the lessons to introduce more individual contact time.

HOW CAN FLIPPED LEARNING IMPROVE MOTIVATION?

Having considered how homework tasks serve to motivate, following discussions with two colleagues in school x who have been using flipped learning in their science teaching, I have decided to explore a homework intervention which involves setting flipped learning homework tasks. Before describing the methodology the final section of my literature review is to consider the research into flipped learning and whether it can help to increase motivation.

The concept of flipped learning emerged in the early 2000s and is also sometimes referred to as 'inverted teaching' (Ryan & Reid, 2016). At the heart of the principle is a move away from teacher-led lecturing or didactic teaching methods to a position where the teacher is more a facilitator. I made the point earlier that the idea of flipping lessons is not new, with the first documented use in the 11th century (Bergman and Sams, 2012, Farrell & Danby, 2015). 'The essence of the flipped pedagogy is to stage learning of new material before class to free up class time for more in-depth explanation, practice, and productive use of knowledge' (He, Holton, Farkas & Warschauer 2016). The principles of lesson flipping are that pupils are asked to cover much of the subject content or lesson theory prior to the lesson. Pupils can then use lesson time and their teacher's expertise to review the content and complete other activities to help consolidate this knowledge. He *et al.* (2016) give a very general definition of flipped lesson as being "events that have traditionally taken place inside the classroom now take place outside the classroom and vice versa" (He *et al.* 2016). They go on to give more specific instructions as to what a flipped learning environment should look like:

> (a) mandatory pre-class learning of new material followed by (b) in-depth explanation, practice, and productive use of knowledge in class through active learning techniques, where (c) class attendance is mandatory. All three features are necessary. First, pre-class learning is an integral part of instruction. Long before flipped instruction was studied as a distinct pedagogy, in- structors were known to assign textbook material for students to read before class. (He *et al.* 2016: 61)

Evans describes flipped teaching as:

> Students are given videoed lectures to watch at home and in class the teacher sets work that would usually be given out as homework. In this way the classroom is "flipped", with the lesson taking place in the teacher's absence and the actual applied learning happening in the classroom, with the added benefit of the teacher being present to help facilitate it. (Evans 2012: 2258)

Black and Deci (2000) argue that helping to increase pupils' autonomy also increases their motivation and this is at the heart of flipped learning. Flipped learning allows pupils to cover material and at their own pace and in their own time, they are therefore given the responsibility and the autonomy to learn in their time rather than in class time. In a study into gender and self-efficacy Pajares (2002) recognises that we should look at factors which serve to de-motivate and try to combat these. He suggests that self-assessment and goal setting may be helpful and this therefore links to both intrinsic and extrinsic motivational frameworks.

Bergmann and Sams (2012) have pioneered the flipped learning concept in the U.S.. Salman Khan founded the Khan Academy, an online collection of tutorials in topics ranging across a huge range of subjects. There are currently 2200 videos watched by about 1 million subscribers (Khan, 2011). In his TedTalk, Khan talks about the ability of pupils to watch the videos as a homework task which will then allow the teacher time in the lesson to review the content the next lesson. This in turn allows the teacher time to interact with the pupils and humanises the classroom, allowing the teacher more time to talk to individual pupils. He goes on to say that he does not mind about failure but encourages mastery of the topic. Khan's website is now developing to include questions and directs pupils to different activities depending on how many questions they get correct. Bergmann and Sams (2012) support Khan's (2011) views, in his inspiring TEDTalk on the subject, in highlighting that the benefits of flipped learning are that in the lesson the teacher is able to offer one-to-one attention to more pupils. The literature review into independent learning which I have previously referenced (Meyer *et al.,* 2008) mentioned scaffolding as critical to increasing motivation. Equally as important was the shift from teacher to student activity, but for this to be effective the support from the teacher was recognised as pivotal. Bergmann and Sams (2014) also link flipped learning to the motivational idea of mastery orientation, thus suggesting how it can be used to increase motivation. I would suggest that it also directly links to the principles of SDT and self-efficacy as not only does it give the pupil responsibility for learning but it also gives the pupils the tools (in the form of the video clips) thus promoting self-efficacy.

Several studies have looked into the impact of the flipped method on learning. He *et al.* (2016) studied the use of lesson flipping in undergraduate students and found that flipped learning did not increase

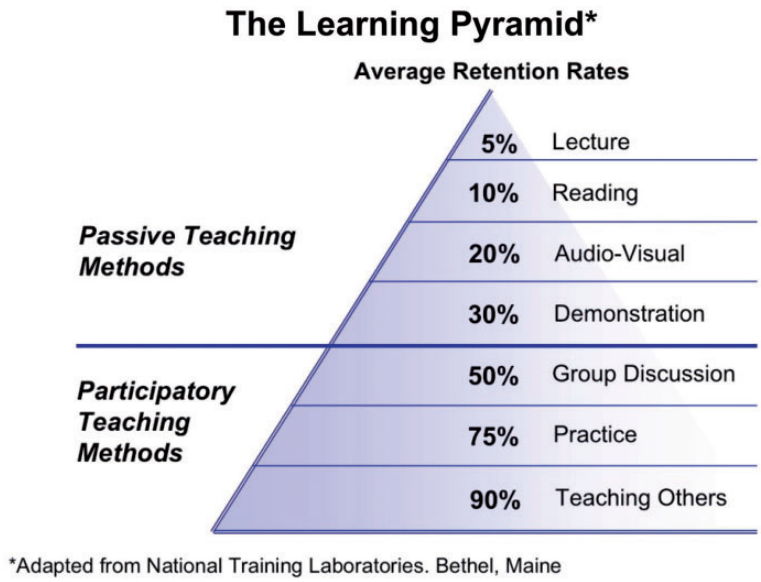


Figure 2. The learning pyramid.
Adapted from National Training Laboratories, Bethel, Maine. (Chen, 2016: 418)

pupil motivation but did have a large effect size on pupil attainment. Although their findings are informative, they are not explicitly relevant to secondary school pupils. Deslauriers, Schelew, and Wieman (2011) again looked at undergraduates at the University of British Columbia. They discovered that even when replacing the experienced professor with a postgraduate who employed flipped learning there was a huge effect size of 2.5 standard deviations and exam scores were 71% in the treatment group as opposed to 41% in the control group. They highlight that the method was also popular with students, attendance increased by 20% which I suggest reflects increased motivation. Figure 2 above shows the average retention rates based upon different methods of teaching. The diagram has obvious relevance to the flipped classroom concept. The traditional homework task of note taking is indicated as being half as effective as asking the pupils to watch/listen to audio-visual. By contrast He *et al.* (2016) used flipped learning with undergraduate chemistry students and monitored a number of factors: performance in exams; preference; perception; motivation. The affect on exam results was small but significant, however, the impact of the flipped learning decreased over time. 20% of students showed very polarised attitudes towards the method and felt very strongly for or against. Interestingly, and particularly relevant for my study, the undergraduates did not recognise an increase in motivation.

More explicitly relevant to school x was a small studied carried out by a colleague in 2014. He used a small group of sixth form students to investigate the impact of flipped learning on International Baccalaureate (I.B.) chemistry lessons with year 12 and 13. He carried out an intervention involving flipped learning where pupils watched tutorial clips outside the lessons before consolidating with questions in the lessons. After the intervention the pupils showed improvement in their test results (Nicholas, 2014) but gave no indication of motivation.

Chen (2016) recognises that a typical flipped lesson will involve teachers posting powerpoints and short videos online for pupils to be able to watch at home prior to the next lesson. The next lesson can then involve much more in the way of collaborative learning exercises, projects and discussion. Chen (2016) found students initially resistant to flipped learning and therefore arrived to lessons unprepared.

Flipped learning has been widely researched in recent years with encouraging results. Although many of these studies do not make reference to the out of class activities as being 'homework', based on the definitions given it surely qualifies as such. Various studies have considered flipped learning in universities (Deslauriers, Schelew & Wieman, 2011, Touchton, 2015, He *et al.*, 2016). The essence of these studies is that flipped learning finds that pupils are more involved in the learning process again, increasing self-determination. It also links to Smith *et al.* (2005) in their consideration of motivation in that they recognise that pupils should develop a range of techniques to help their learning autonomy and self-regulated learning. Flipped learning addresses both of these aspects of motivation as well as evidence from Plenty and Heubeck's (2011) study in Australia which found that academic achievement is influenced by engagement in the learning process. I am interested to investigate if flipped learning engenders greater feelings of involvement in the learning process such as is referred to in the quote below from Touchton's research:

> The flipped classroom can thus give students the opportunity to teach one another, which requires them to learn the material more thoroughly than a simple homework application would otherwise demand. In this way, the flipped classroom can also cultivate a broader sense of teamwork among students and render it easier for them to form study groups outside of class. (Touchton, 2015: 30)

Baepler, Walker and Driessen (2014) worked with a university in the U.S. to flip lessons and looked at the perception of students and learning outcomes. They considered whether it would be possible to

reduce contact time and still get results. They also changed the layout of the classroom so that pupils sat around tables together. Their findings are summarised:

> The students achieved learning outcomes that were in one case superior to, and in the other case statistically equal to, the outcomes from the traditional classroom when measured by standardized exam, and their perceptions of their learning environment were improved. (Baepler, Walker and Driessen, 2014: 235)

These data and results agree with Nicholas (2014) and highlight that flipped learning has been effectively used to increase attainment. Further evidence in support of the impact of increased self-regulation and motivation in undergraduate students in Padua, Italy, were shown to mediate the impact of emotions on academic achievement (Mega, Ronconi & De Beni, 2013). They used a different motivation questionnaire to that which I will use, but their research still reflects the positive impact of increased motivation. Hong *et al.* (2015) also found that motivated learners see tasks as important but also that they persevere and have high self-efficacy when tasks are difficult and therefore show the same self-regulation properties to which I referred to earlier when discussing Corno's (2000) research.

In summary there is much evidence to suggest that flipped learning will impact pupil learning and studies have found an impact on attainment. Kettle (2013) conducted a study in A level classes in Cambridgeshire. She found that the 'best pupils' pupils produced excellent notes and flourished during the process but that 'weaker and less-diligent pupils' floundered during the process; they found it hard to construct notes and were often left with nothing to show. This agrees with Torrance and Coultas (2004) who found that pupils start year 12 biology courses disengaged and ill equipped, often lacking the motivation or skills to progress. Kettle also suggests that the hard-working pupils were challenged as they could not calibrate their notes. In response to this she used scaffolding which concurs with Meyer *et al.'s* (2008) study on both their point about scaffolding being crucial for independent learning and also that feedback on homework is crucial. Kettle concludes that flipped learning is effective for motivated pupils. She also found that searching for ideas on a topic was time consuming, so I would raise the question why the link to an appropriate idea clip could not be given to pupils? A study by Jeong (2015) in Korea, is one of the few I have found which specifically looks at the effect of flipped learning on motivation. So although this study would seem to be very relevant the

research was carried out on Korean mathematics undergraduate students and so context differs hugely. Jeong is vague in his conclusions, saying that the impact was 'a little bit affirmative in the aspect of motivation'. The study does not provide clear evidence but he found that the introduction of flipped learning did make students more motivated to learn calculus. Further to Kettle's points above, Jeong also mentions the need for explanation of the process to the students and the need for feedback and support; these ideas come through strongly in most studies into independent learning which includes flipped learning. Jeong also found that there is a need for video content to be uploaded for ease of access.

Jeong, Bae and So (2015) conducted another study in Korea into the effect of flipped learning on motivation. It should be noted that that both of these Korean studies were published by journals I am not familiar with and therefore this perhaps slightly weakens the strength of their findings, nevertheless I referred to them as they specifically looked at flipped learning and motivation in biology classes. In their abstract they highlight that they found that flipped learning increased both learning motivation and academic achievement. I have been unable to acquire a translation of the full text which reduces the validity of this as a source. As I have narrowed my focus to the use of flipped learning and its impact on pupil motivation in science lessons, I have been surprised to find that there have not been more studies completed investigating any link.

My study raises the question of whether flipped learning can be a motivating process. There is not a great deal of research specifically monitoring pupil motivation but flipped learning can improve attainment levels which I expect may lead to increased levels of grade motivation. It is also recognised as giving pupils greater ownership and control of their learning, so this in turn is likely to increase their self-determination and self-efficacy. The research I have completed into motivation and flipped learning have led me to construct a research question which I will investigate further.

RESEARCH QUESTION

Following my literature review of the areas of motivation, homework and flipped learning I have decided to investigate an intervention using flipped learning. I will investigate whether flipped learning affects pupil motivation in answer to the the research question below:

What is the impact of using flipped learning homework tasks on pupil motivation?

3. METHODOLOGY

INTRODUCTION TO METHODOLOGY

Since motivation is such a broad topic I simplified my research question to consider an intervention in one area, looking at a specific type of homework task. As motivation is a multi-faceted construct I recognise that the ability to measure motivation is pivotal in my study. I will discuss below the measurements used and adopted the Science Motivation Questionnaire II (SMQII) developed by Glynn *et al.* (2011). In my literature review I highlight the different aspects of motivation (extrinsic grade and career, intrinsic, self-determination and self-efficacy) and the SMQII measures all of these elements which will allow for useful comparison. In addition to data from the questionnaire I also collected data in the form of focus group interviews in order to gain insight into the views of the pupils as individuals. Importantly this gave me a chance to collect information on how pupils perceived the process of flipped learning affects their motivation and provided the opportunity for them to express their views.

I used a model of action research because, as stated by Cohen, Manion and Morrison (2007), this allows for the planning implementation, review and evaluation of an intervention. It is also designed to allow reflective practice and collaborative research. All of these elements of action research are appropriate for my study. It allowed me to introduce flipped learning to the pupils and conduct one cycle from January to mid February (half-term). I then reviewed the process using focus groups and questionnaire data before conducting a second cycle from late February to March.

Below I give further detail about the methodology I used to implement this intervention.

COLLABORATION

Having looked in detail at the range of factors influencing motivation and then the range of strategies which can be used for homework tasks I decided to narrow the focus of this study. I decided to investigate homework further as it is a topic which is being considered on a whole school basis in school x. School x has a system of Mutual Observation Groups (MOGs) which are small (made up of about 10 teachers) groups of teachers who meet on a regular basis to discuss professional practice. Following my study of homework in 2016 I presented my assignment for their consideration. In discussion with the director of teaching and learning homework was then chosen as the topic for consideration in MOG groups in 2016-17. Some colleagues in the science department have been using a degree of flipped learning with their classes and I was interested to trial flipped learning methods with the pupils whom I teach.

The topic of homework is being researched by the director of teaching and learning and the MOG group leaders. They have been sampling the student body with questionnaires in a review into how homework can be used most effectively. At the start of the academic year I discussed this study with my own MOG group and outlined the intervention in more detail with my MOG leader. At the end of my intervention period I presented my findings to my MOG group and all MOG leaders. This will feed into their review and I hope to present my study to all teaching staff at an INSET day in the following academic year.

PARTICIPANTS

In the process of action research I used two classes of year 12 A level biology pupils. They are in the first year of a two year A level course and will therefore not have the pressure of building towards external exams at the end of the year. I chose this year group as I teach two sets of differing ability so this will allow for interesting comparisons. Year 12 pupils will also be of an age that they are able to contribute their ideas in the focus group. They are required by the school to have their own computers so they have access to the video clips on the internet. Also, being A level biologists they will hopefully be eager to involve themselves in action research may help develop them as more complete learners.

A summary of the individual make up of the teaching groups is shown below in Figure 3, I will refer to them as Set A and Set C.

Set A: 11 pupils: 4 boys and 7 girls; average age at 1st September - 16.7yrs.

Set C: 7 pupils: 5 boys and 2 girls; average age at 1st September - 16.5yrs.

SET	GCSE Average Points Score	ALIS GCSE Score	ALIS Prediction	ALIS Test Score	ALIS Prediction
A	**7.45**	124	A	109	B
A	**7.91**	125	A	90	C
A	**7.3**	106	B	90	C
A	**7.82**	122	A	90	B
A	**7.09**	100	B	92	B
A	**7.45**	111	A	88	C
A	**7.67**	118	A	116	A
A	**7.5**	112	A	93	B
A	**7.6**	116	A	105	B
A	**7.7**	119	A	62	D
A	**7.09**	100	B	59	D
Mean	**7.51**	113.9		90.36	
C	**7.67**	105	B	116	A
C	**7.00**	117	A	116	A
C	**6.1**	69	D	79	C
C	**6.3**	75	C	80	C
C	**6.8**	91	B	69	D
C	**6.6**	85	C	93	B
C	**6.1**	69	D	90	B
Mean	**6.65**	87.3		91.86	

Figure 3 - A table showing the individual and mean baseline data scores for Set A and C

As described in the literature review flipped learning is defined as the use of time before the lessons to learn new content which allows for greater time in the lessons for consolidation of this content. Between January and March, 2017, rather than using homework time for answering exam questions, writing essays or other homework tasks I set them homework which required them to use the Khan Academy (https://www.khanacademy.org) videos and make notes on the topic concerned. This allows pupils to spend time watching the video clips and make notes in their own time, re-watch the clips as necessary and also use other sites or their text books if they wish. The following lesson they then had the chance to ask any questions they may have, answer practice exam questions or complete practical work.

METHOD

The Science Motivation Questionnaire was developed by Glynn (Glynn & Koballa, 2006). It is based on the social cognitive theory of human learning developed by Bandura (1986). As Schumm and Bogner (2016) highlight, it combines the internal and external aspects of science motivation: grade motivation; career motivation; intrinsic motivation; self-efficacy; self-determination. The questionnaire was developed with a view to helping educators highlight which of the pupils they teach were motivated and therefore which lacked motivation. This would then allow teachers to attempt to alter their teaching strategies to help those who lacked motivation. The questionnaire was refined by Glynn to help to develop the Science Motivation Questionnaire II (SMQII) (Glynn *et al.*, 2011). When considering motivation in Science it is challenging as it cannot be directly measured. The variables concerned with whether a student maintains motivation can be considered as 'latent variables'; these cannot be directly observed, however, there are empirical indicators which can be termed observed variables which, as the name suggests, can be observed and measured. Schunk *et al.* (2014) highlighted several ways in which motivation can be investigated: direct observation; ratings by others; self-reporting. Self-reporting could be in the form of questionnaire, interviews, stimulated recalls, think aloud, dialogue. Given the nature of the fact that homework is usually carried out at home, it makes any direct observation of pupils very difficult. The pupils in school x do complete homework in their

study bedsits as it is a boarding school, however, as they work in their own bedsit I considered observation of this to be intrusive and ethically inappropriate.

Given these considerations I decided to use a questionnaire. The questionnaire allowed me to sample each of the pupils in both of the teaching groups. I therefore obtained data from all of the subjects before I started the intervention, after the first cycle and finally at the end of the second cycle. Cohen, Manion and Morrison (2007) suggest that a questionnaire is a very useful instrument but that its use must be balanced against intrusion. The very nature of motivation is that it is personal and varies between individuals, I wanted to make sure that I had the opinions of each of the pupils involved and the questionnaire enabled me to do this.

The SMQII questionnaire has been validated by research and refined so I decided that it would be more valid to use this questionnaire as opposed to one I have written myself. Glynn *et al.* (2011) have refined the SMQ following earlier research by Glynn, Taasoobshirazi, & Brickman (2007, 2009). The 2009 study found that the questionnaire should be refined to improve its construct validity and I used the modified SMQII version. The SMQII has been designed so that statements are simple and deemed easy to read. Glynn *et al.* (2011) performed a Confirmatory Factor Analysis to further validate their measure of motivation which identified 5 factors that had eigenvalues greater than one, accounting 67.64% of the variance. I contacted Shawn Glynn and enquired as to the validity of the questionnaire for the purpose I was using it for, and I also requested permission to use SMQII

The questionnaire is designed to allow very simple administration as it has 25 questions with a scale of 0-4 for each question. The questionnaire is made up of five question areas designed to assess motivation in the following areas:

Intrinsic motivation;

Self-efficacy;

Self-determination;

Grade motivation;

Career motivation.

This gives a total score out of 100 with each area being out of a maximum of 20.

The conditions of the SMQII were adhered to and the questions altered to refer to homework in biology rather than science in order to make it specific to the topic of 'homework'. A copy of the questionnaire is shown in appendix 1.

In designing the above method I followed BERA ethical guidelines (BERA 2011). CUREC approval was obtained from the University of Oxford ethical committee. I wrote to the headmaster (appendix 2) before embarking on my research and obtained signed consent from him. The pupils concerned were all over 16 so could be treated as competent youths and according to BERA guidelines I did not need written permission from their parents. I was careful to consider whether the pupils' education would be adversely affected by the intervention. They would still be covering the topics in the correct period of time so would not negatively impacted. Indeed I hoped that they would develop greater self-regulation and that this would increase their motivation.

All of the pupils were verbally introduced to the study and asked if they would consent to being involved. The SMQII was administered in one of the class' normal Biology lessons so that the pupils were not required to spend extra time on the survey. The questionnaires were administered anonymously but the class they are in and their gender recorded.

As well as the SMQII I assembled one focus group from each of the two teaching groups made up of four pupils. Focus groups were chosen as they gave the pupils a chance to feedback their thoughts about the flipped learning and for me to assess their thoughts. Permission was sought to take audio recordings of the interviews for analysis at a later date. The recordings were stored on a school computer and permission from the headmaster. I used the same questions with both focus groups and used these informal focus groups to ask the group their views. I was conscious that I wanted pupils who were keen to offer opinions so gave them the opportunity to volunteer. I recognise that this may affect the findings as those who volunteered may already be more motivated, however, I had to weigh this against ethical considerations and could not select a pupil who did not want to be in the focus group. From these volunteers I selected two boys and two girls to make up the focus group. Interviews were carried out at the start and end of each action research cycle so that any comments made could inform the progress of the study.

The first cycle of action research involved the topic of photosynthesis and was carried out between the start of January and February half-term. The flipped learning intervention involved sending a weblink to a clip of a particular topic on the Khan Academy website each week. The pupils were then asked to make notes on the topic concerned from the video. Each week their notes were collected in and I reviewed them, making corrections when necessary, but they were not graded or given a 'mark'. In lesson time, pupils were given the chance to ask questions about the videos and sometimes I reviewed areas with the whole class, they were then given questions to work through relating to what they had done for the homework. It is important to note that the photosynthesis topic is often identified by pupils as being one of the most conceptually challenging of all the year 12 topics. I will consider this in the discussion, but in my experience it is a topic which pupils can find testing and may itself affect motivation.

After the first cycle of action research the views of the pupils from the questionnaires, focus groups and also informal comments made in lessons, were reviewed. The results of the focus group will be discussed in more detail in the next section, but following the first cycle I altered the way that the flipped learning was delivered to take into account the comments made. In the focus groups and informal feedback sessions the pupils highlighted that they found it hard to know exactly what they were meant to know. Some of the terms and names of molecules were hard to understand and both set A and C requested that more support; consequently more structure was put in place.

Following the first cycle of action research some changes were made ahead of the second cycle. The topic for the second cycle was energy flow in ecosystems. When the tasks were set with the use of 'Firefly' (the VLE used by the school) the pupils were provided with pointers and help sheets. On the sheet I provided a list of the key names which they were required to know, as well as diagrams which they could use as a template for some topics. For example, in the Nitrogen cycle, a diagram was given (figure 16) with all the names of key species of bacteria displayed at the bottom of the sheet. At the same time their attention was drawn to the syllabus specification statements which they already had. The second cycle ran between the end of February and March 2017 when the focus groups met again and a final copy of the questionnaire was also given.

DATA ANALYSIS

The SMQ was designed by Glynn and Koballa (2006) and refined into the SMQII by Glynn *et al.* (2011) to assess motivation in the different categories which I am looking to assess. The questionnaires were tallied according to these sections which are as follows:

Intrinsic motivation - Questions 1, 3, 12, 17, 19

Self-efficacy - Questions 9, 14, 15, 18, 21

Self-determination - Questions 5, 6, 11, 16, 22

Grade motivation - Questions 2, 4, 8, 20, 24

Career motivation - Questions 7, 10, 13, 23, 25

This gives each section a maximum score of 20; 20 being answers of '4 - always agree', for each of the questions. In short, the higher the number the more motivated the pupil can be deemed to be. To standardise these data Glynn *et al.* (2011) suggest that they are standardised about the mean. A mean was therefore calculated for each of these section and a standardised value provided. I also calculated an average for each of the sections for Set A and C. The table below (Figure 4) gives a worked example of the data gathered using the SMQII with totals for each section.

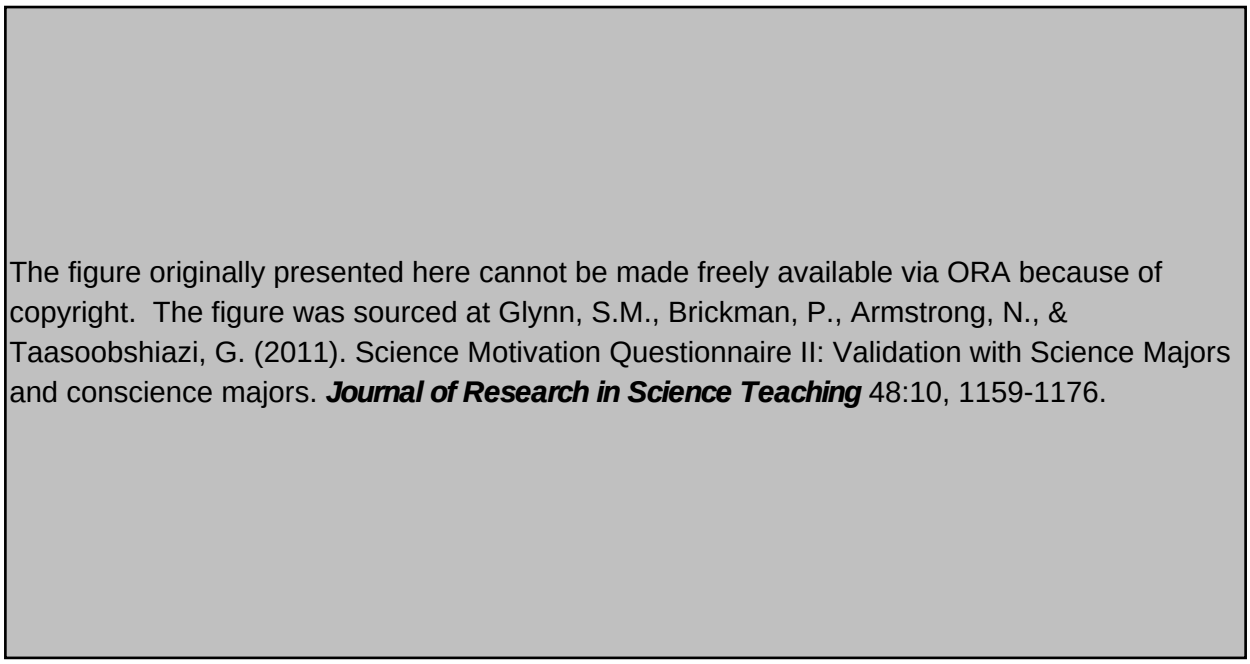


Figure 4 Table to show an exemplar of the data collected using SMQII (Glynn et al., 2011: 1170)

The final analysis was to compare the changes in the pupils' questionnaire responses after cycle one and two of action research. For each action research cycle the value for each of the 5 sections was subtracted from the start value to give a number showing whether it had increased (positive number) or decreased (negative number) over the action cycle. These results could then be plotted on a graph to show increases or decreases in motivation over the two action cycles.

The recordings of the focus groups were then reviewed afterwards. They were listened to and comments transcribed for reference. The recording was then listened to for a second time and any comments categorised into positive, negative or neutral. These were tallied as the recording played to give a total number for these three sections. Individual comments made by pupils were also noted.

LIMITATIONS OF STUDY

There were a number of limitations to the study including its size and scope, but also the nature of the resources and the collection of data to evaluate the intervention.

The nature of the study was limited by the time period available. I had one school term from January to March to carry out research. If time had afforded another stage of action research would have been informative and I would have looked to extend this to other colleagues. I did raise the opportunity for colleagues in my MOG group to be involved but none were forthcoming.

The Khan academy does not have specific videos tailored to the OCR A level specification and this was a weakness of the use of the Khan Academy. I did consider making my own videos which I could tailor to the specification but attempts to do so produced a video which was much less clear and refined than those of Khan. Following comments from Set C in the focus group I did research other videos on the internet but did not find any of the same quality as the Khan Academy.

The number of pupils involved in the study was small (18 in total). This has the benefit that I know each of the pupils well and as I teach each of the pupils I was able to record informal observations and comments which they made. I compared means of the questionnaire totals and used standard deviation to compare these, but further statistical tests could not be performed because of the small sample size.

Focus group discussions and completion of questionnaires took place in lesson time, however, due to the school's two week timetable it was not possible to sample the pupils at the same time of the day or week. I was conscious when interviewing and taking the questionnaire that the time of day and time of term may well affect the nature of their responses. For example, I convened Set C's focus group just before lunch on one of the occasions and I felt that their responses may have been slightly negative as a result. Although it was not possible to avoid this, it is nevertheless, a slight weakness in the method.

In summary my intervention involved two cycles of action research. The intervention involved the delivery of flipped learning homework tasks in the form of watching and taking notes on Khan Academy video clips followed by review and consolidation in lessons. Pupils' motivation was measured using both the SMQII and focus group interviews and the results considered below.

4. RESULTS

To return to the research question which I was aiming to investigate:

What is the impact of using flipped learning homework tasks on pupil motivation?

In order to answer this question I will review the results from focus group interviews and then consider the SMQII data.

ANALYSIS OF FOCUS GROUP INTERVIEWS

PRE-INTERVENTION

Initial thoughts on the purpose of homework from sets A & C included the following:

Consolidates things learnt in lesson; helps to revise topics; deepens understanding of topics; reinforces understanding; sometimes set research topics.

These views are very similar to those expressed in my research last year (Lyon Taylor, 2016). The idea that homework consolidates knowledge is one which is supported by much research (Cooper, 1989, 2007, Xu, 2005, Yasemin, Semra & Ceren, 2014) and widely held by pupils at school x. Unsurprisingly, this was the view which came through most strongly in the interviews. Many have also considered the view that homework improves understanding and attainment (Leone & Richards, 1989, Xu and Yuan, 2003, Xu, 2005, Cooper, Robinson & Pattall, 2006, Petty, 2006, Cooper, 2007) which is the view which I found many teachers subscribe to and also came through in my pre-intervention focus group discussions. Pupils talked of enjoying doing homework so that they could tick them off and get the tasks done. The Firefly app. has a box next to each task set which pupils must mark as done and they spoke of this being motivating. There was a sense from their comments, that they enjoyed completing the task rather than the process of doing the homework. To return to comments from research carried out by Smith *et al.* (2005) into motivation, if something is to be motivating they found that it should be fun and it did not seem as if they found it so. Relevant to this study, pupils identified that they liked writing notes which 'look nice' and can be used for revision, by contrast two of the boys did not find note making a useful exercise. They were set varied tasks for homework but questions were often not seen as of value as often they found these were just reviewed

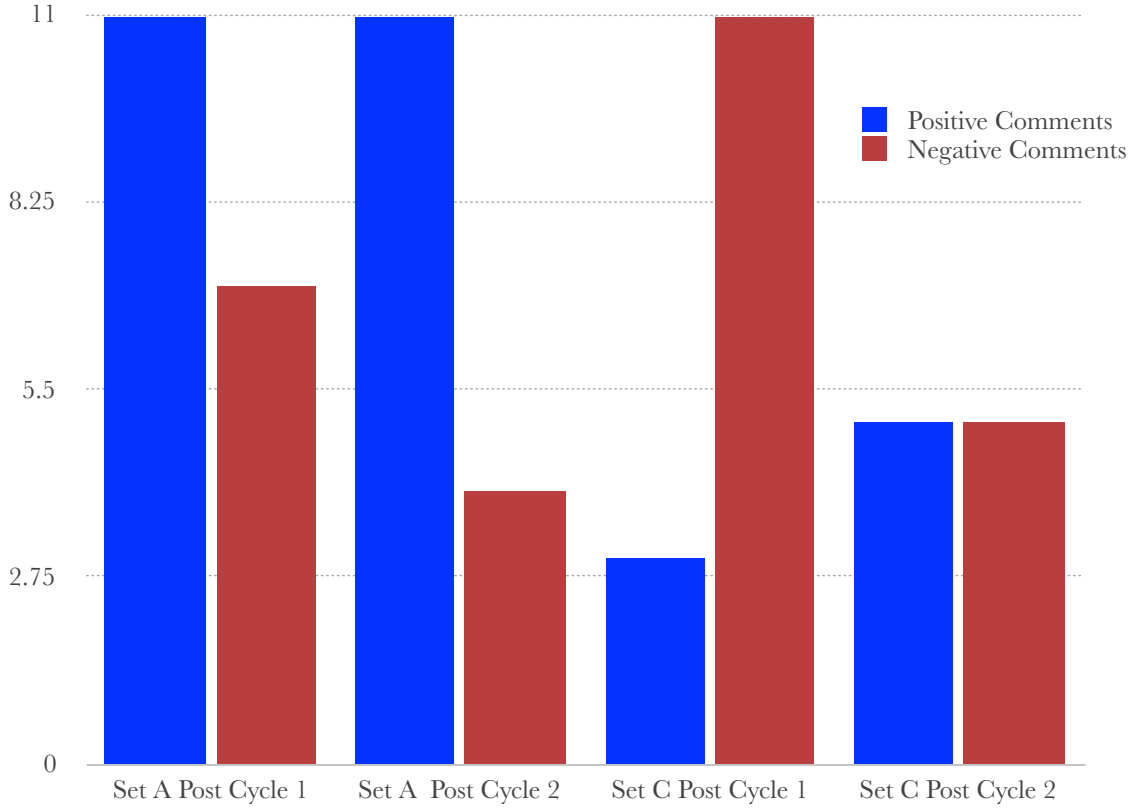
in the next lesson, or sometimes not marked by the teacher. Equally, often they were asked to prepare presentations and whilst they saw value in this for the person preparing and presenting, they did not feel that they learned from watching others present to the class.

The pre-intervention interviews provided me with a chance to talk to the two focus groups. It was useful in getting them used to talking whilst being recorded, something they were initially a bit hesitant about. The views they presented did not differ greatly from the views I collected last year and they agreed with other research into the value of homework (Warton, 2001, Coutts, 2005, Xu, 2005, Hutchison, 2011) with the strongest views to prevail being that it helps in consolidating work covered in the *previous* lesson; significantly, this in stark contrast to flipped learning principles which covers new material for homework ahead of the *next* lesson.

FOCUS GROUP COMMENTS AFTER 1ST CYCLE OF ACTION RESEARCH

The results of interview focus group analysis are presented below in figure 5 along with a brief summary of some the comments made in figure 6. It can be noted that in set A the there were many more positive comments than negative after both action cycle one and two. By contrast in set C there were many more negative comments after cycle one but after cycle two this number had decreased and the number of positive comments increased. The majority of the negative comments from set A related to the time which the flipped learning tasks took and not necessarily a criticism of the process itself.

Figure 5 - Graph showing the number of positive and negative comments made in focus group interviews after action cycle 1 & 2



	Positive	Negative
Comments made by pupils	Different; remember tasks well; like arriving to lessons with prior knowledge; enjoy listening; good for visual learners; want to do well; motivating;	Takes a long time; hard if don't understand as no-one to ask; videos are complex; poor presentations; don't know what we are supposed to know; hard topic; demotivating; shouldn't be used for difficult topic.

Figure 6 - Table showing examples of comments made during focus group interviews.

To summarise, after the first cycle of action research the focus groups from both set A and C discussed their thoughts on the use of flipped learning for the photosynthesis topic. This revealed some distinct differences between the two groups, and these will now be explored in more depth.

Set A

As shown in figure 5 above there were 11 positive comments and seven negative. The pupils had enjoyed coming to the lesson with prior knowledge of the topic, especially the complicated topic of the light dependent reaction and the Calvin cycle. They mentioned that it was hard not knowing which elements of the video were important to note down and as a result some of their notes included too much detail. Interestingly, as you can see below in figure 7, I did not feel the pupils had included enough detail, for example the names of molecules in the Calvin cycle. The names of some of the molecules referred to in the video were slightly different to their course specification and this led to some confusion. The most common negative sentiment was that it took them a long time to complete the task. Each of the videos was approximately 30 minutes long and the pupils reported that the task took about two hours to complete. Some of the pupils found it hard to follow the Khan videos and decided to look up other videos or to use their text books or other sources to help them. In doing so they showed intrinsic motivation with evidence of self-determination, SRL and self-efficacy. Some of set A suggested that they would like greater guidance of what they needed to know. Although pupils have a copy of the course specification they requested a check list or questions mapping their way through the topic. Although one pupil said that he hadn't really noticed any difference, most of Set A were positive and the focus group were all keen to continue into a second cycle of action research. As described in the methodology section, their comments fed into the structuring of the second cycle of action research.

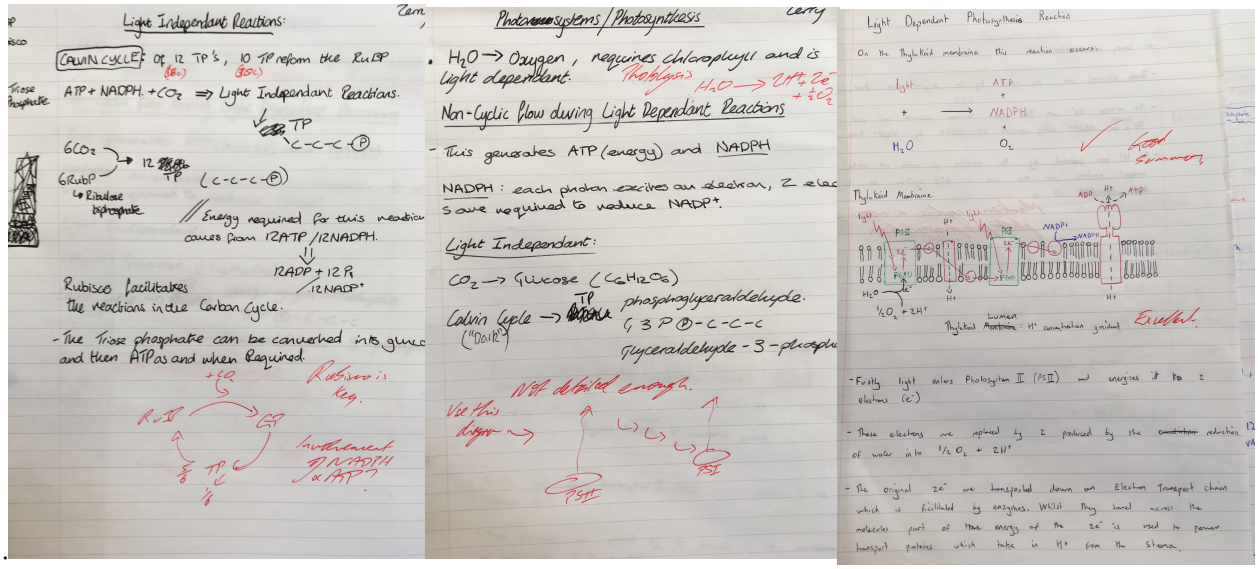


Figure 7 - Examples of Set A pupil notes after photosynthesis, showing lack of key details from reactions

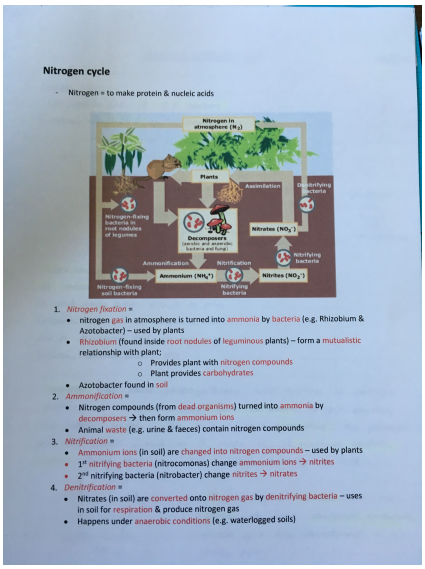
Set C

As figure 5 shows after the first cycle set C made 11 negative comments and only three positive comments in the focus group. This was allied to the informal comments which I had received in lessons alerting me to the fact that they found the process challenging and hard to execute. The thoughts of this group were summarised by one male pupil in the group: "I feel that it is a good idea but wonder whether it works for a tricky topic? We should start with a more basic topic to develop the technique and then move onto a more complicated topic". They did not understand the topic of photosynthesis and therefore found the videos very confusing. The diagrams used by Khan were thought to be too small and this hampered their ability to understand it. Another boy commented that we should stop using it for difficult topics. There were positive comments and one boy said: "I find it motivating because I want to do well", another said, "It can be motivating to work alone but it can also be difficult if you get stuck". They summarised that they felt additional questions were needed to help them structure their work and also observed that they had found the presenter's accent hard to follow and that the notes he made on the screen were hard to read. I gained an insight into their adept use of technology as they had discovered how to slow down the video and to pull up subtitles underneath which had been helpful when making notes. Others had used their text books and found this much easier to copy out notes. Although, as with group A this shows some SRL the very process of copying does not allow the pupils to process their notes. The strong feeling from Set C was that they needed more support with the flipped learning process. As explained in the methodology section a decision was made to alter the delivery in response to these comments.

FOCUS GROUP COMMENTS AFTER 2ND CYCLE OF ACTION RESEARCH

Set A

As shown in figure 5 the number of positive comments from set A remained at 11 but the number of negative comments decreased after the second phase of action research. One girl commented that she very much preferred having the additional structure and the ability to use sheets to help her make notes. Figure 8 shows how someone who has used the diagrams given to structure good notes.



Nitrogen cycle

- Nitrogen = to make protein & nucleic acids

1. *Nitrogen fixation* =
   - nitrogen gas in atmosphere is turned into ammonia by bacteria (e.g. Rhizobium & Azotobacter) – used by plants
   - Rhizobium (found inside root nodules of leguminous plants) – form a mutualistic relationship with plant;
     - Provides plant with nitrogen compounds
     - Plant provides carbohydrates
   - Azotobacter found in soil
2. *Ammonification* =
   - Nitrogen compounds (from dead organisms) turned into ammonia by decomposers → then form ammonium ions
   - Animal waste (e.g. urine & faeces) contain nitrogen compounds
3. *Nitrification* =
   - Ammonium ions (in soil) are changed into nitrogen compounds – used by plants
   - 1st nitrifying bacteria (nitrocomonas) change ammonium ions → nitrites
   - 2nd nitrifying bacteria (nitrobacter) change nitrites → nitrates
4. *Denitrification* =
   - Nitrates (in soil) are converted onto nitrogen gas by denitrifying bacteria – uses in soil for respiration & produce nitrogen gas
   - Happens under anaerobic conditions (e.g. waterlogged soils)

Figure 8 - Example of set A pupil notes after Nitrogen cycle video showing good use of scaffolding provided in form of Nitrogen cycle diagram.

Another girl made excellent notes and felt she developed a good understanding without the need to use the structure given. This same girl was very astute in her observations and, perhaps because she enjoys flipped learning, would like to move exclusively to this style of homework. Most of the others in the group recognised that variety is good and that if each subject moved to this style of teaching then it would take them much longer to complete their work outside lessons. Once again the pupils found that it took them a long time to complete the task, up to about 1 hour 45 minutes. As explained in the methodology, a limitation of the study was the quality of video clips which I found available; the pupils did mention this as a frustration as they felt that the clips were not specifically tailored to their OCR exam board. It was encouraging to hear the pupils speak positively about the technique and they recognised that it was a new way to learn which they had not used in other subjects. One girl commented that: "it sticks out in memory as it is a new way of learning, so I feel like I do remember it better. Perhaps if did it for all subjects/topics then it wouldn't stick out so much".

Set C

As the graph in figure 5 shows there was a slight increase in the number of positive comments made by set C after the second cycle of action research. The number of negative comments also decreased from 11 to 5. This set were still not very positive about the concept. One pupil opened by saying that: "It doesn't work for me. It is a good concept but not sure how well it applies. Varies on class and I wouldn't say that this class is very independent". Another pupil commented that: "it is easier as you can get away without doing the work even though you then pay later on with poorer knowledge". One pupil even used the word demotivating and suggested that it shouldn't be used for a difficult topic. As with the first cycle, even with the prompt sheets they found that although they recognise the idea is good they found the video difficult to follow. Another in the groups recognised that the video was very helpful as it could be slowed down and re-played and that it was well explained. Set C again mentioned problems in the way it was presented on the screen and found this very hard to follow and watch. They found the notes were quite useful but as figure 9 below illustrates, none of the pupils actually used the notes or diagram to formulate their notes. This led to weaknesses and omissions in their notes which are a concern to me as their teacher as they do not have set of notes to which they could refer back to. In summary, it seems that for Set C, the flipped learning concept was quite stressful and challenging. The pupils recognised that it did develop skills and help them become more independent. As one of the pupils said: "It makes you realise you have to find your own way of getting to grips with the information".

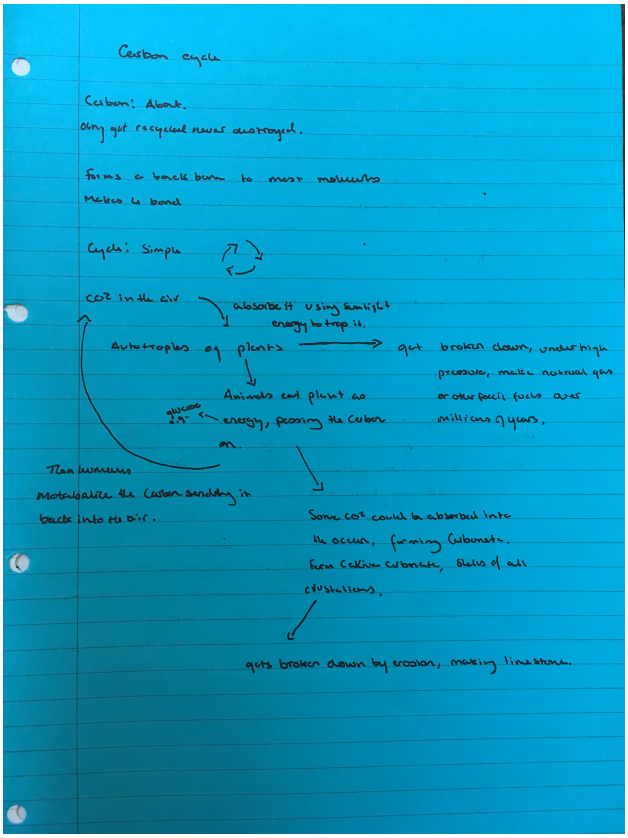


Figure 9- Example of Set C pupil notes after Carbon cycle video showing that the scaffolding provided had not been used.

The contrast between the views shown by the two sets will be discussed further in the discussion section, before doing so I will now consider the results gathered from the questionnaire data.

ANALYSIS OF SMQII RESULTS

The SMQII was administered to each of the pupils in sets A and C before the start of the intervention and then at half-term in February and finally at the end of cycle two at the end of March.

The analyses of the SMQII are shown below in figure 10. The values displayed are the mean values for each set with the standard deviations shown below. With a maximum value of 100 the overall motivation index of set A and C varies at the pre-intervention stage with a mean of 64 (SD9.0) compared to 58.6 (SD16.5) for set C. Interestingly the values for set A are higher in all categories with the exception of self-efficacy in which set C have a mean of 14.1 (SD3.8) compared to 10.9 (SD4.0) for Set A. As I explained with such a small sample size, statistical analysis is not possible, but comparison of the means is interesting, keeping in mind the large standard deviation.

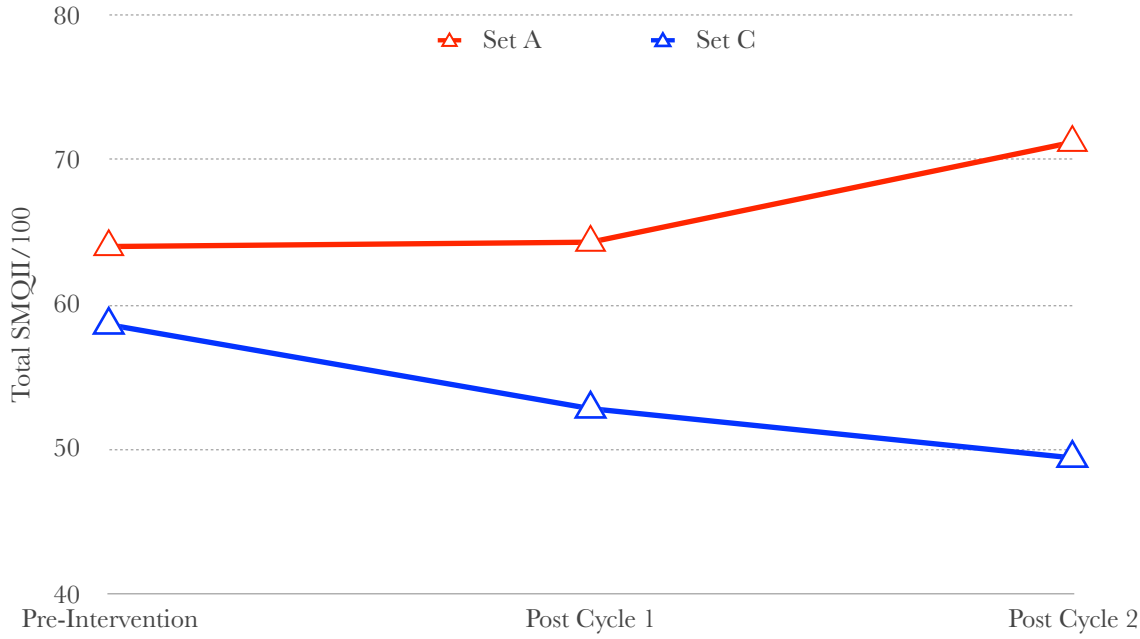
	SET A			SET C		
	PRE-INTERVENTION	POST CYCLE 1	POST CYCLE 2	PRE - INTERVENTION	POST CYCLE 1	POST CYCLE 2
INTRINSIC MOTIVATION	11.5	11.6	12.4	9.9	10.8	9.3
Standard Deviation	2.2	3.0	4.2	3.3	2.8	4.5
SELF-EFFICACY	10.9	12.0	14.1	12.5	9.7	10.0
Standard Deviation	2.5	4.0	3.8	2.5	4.2	4.5
SELF-DETERMINATION	12.8	13.0	13.0	10.6	9.8	10.0
Standard Deviation	2.5	2.3	2.2	1.7	2.1	5.4
GRADE MOTIVATION	15.7	17.5	17.3	14.4	11.7	11.7
Standard Deviation	2.7	5.0	1.2	2.9	4.2	6.0
CAREER MOTIVATION	13.0	10.1	14.4	11.3	10.8	9.1
Standard Deviation	4.0	5.4	3.5	4.1	7.1	7.7
OVERALL/ 100	64.0	64.3	71.2	58.6	52.8	49.4
Standard Deviation	9.0	9.9	13.1	16.5	17.4	24.7
Test Score/%	74	64		50	38	
Standard Deviation	14	13		8	18	

Figure 10 - Table to show analysis of SMQII data.

Totals for each motivation component are out of 25, and overall total out of 100.

Figure 11 shows the changes represented graphically. Between the first and second cycles the results for set A stay very similar changing from 64.0 to 63.3. The overall motivation score for Set C drops from 58.6 to 52.8 after the first cycle and again after the second cycle to 49.4 (SD24.7). There is a large standard deviation but this decrease is still noteworthy especially when compared to Set A which increase from 64.3 to 71.2 (SD 13.1) after the second cycle of action research indicating an increase in motivation. After two cycles the overall difference between the two sets is sizeable: set A 71.2 (SD13.1) compared to Set C 49.4 (SD24.7). The very large standard deviation in set C indicates the large differences between individuals and as I have mentioned the small sample size precludes me from doing any statistical analysis on these data.

Figure 11 - Graph showing the means of the overall SMQII totals over two cycles of action research.



Having considered overall total values for the SMQII data it is useful to breakdown the questionnaire data into the five categories. Figures 12 and 13 below show these comparisons for each set over the two research cycles. Set A shows a slight increase in intrinsic motivation over the two cycles but the most notable increase is shown in the self-efficacy category. An unusual change in career motivation with a decrease after cycle one followed by a large increase after cycle 2.

Figure 12 - Graph showing the changes in mean values of motivation for set A over the course of action research

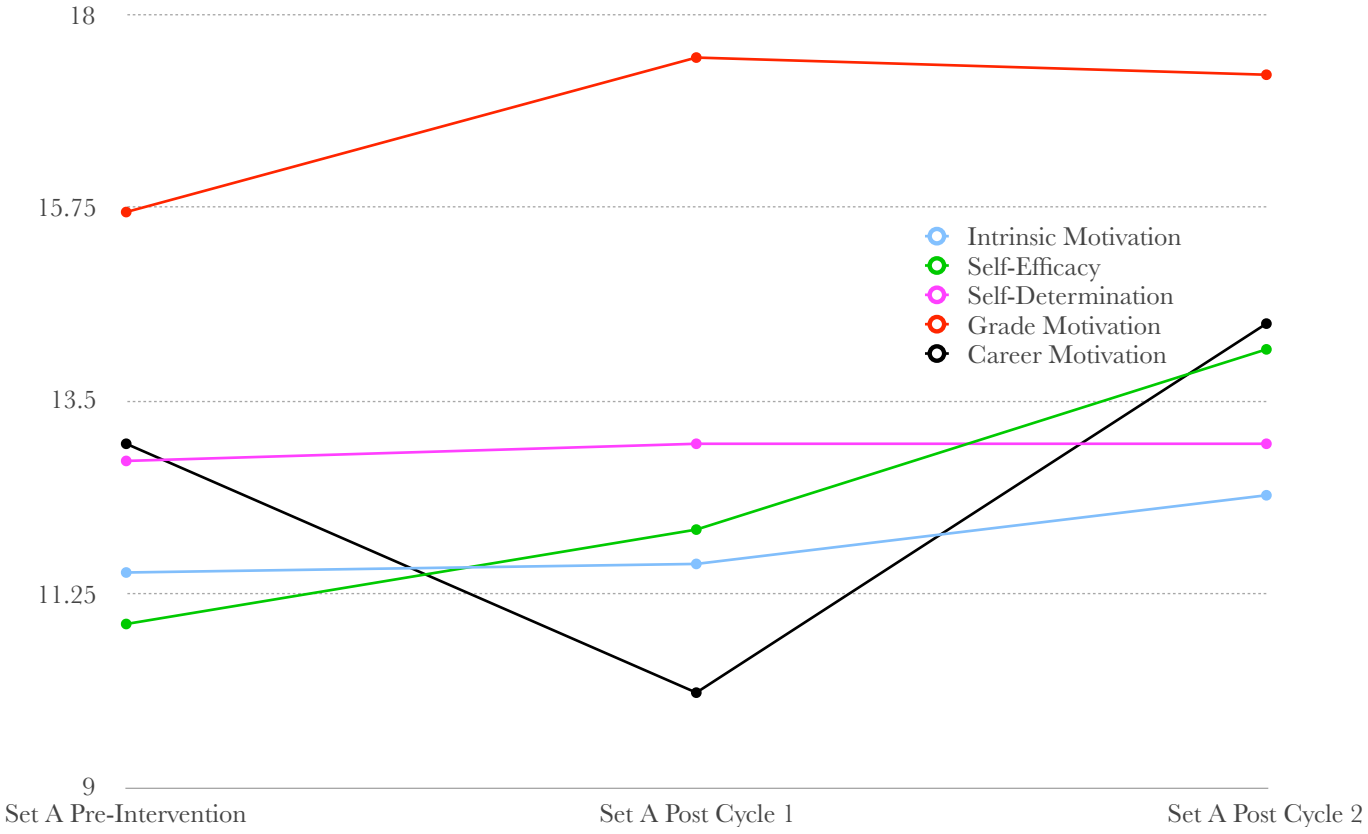
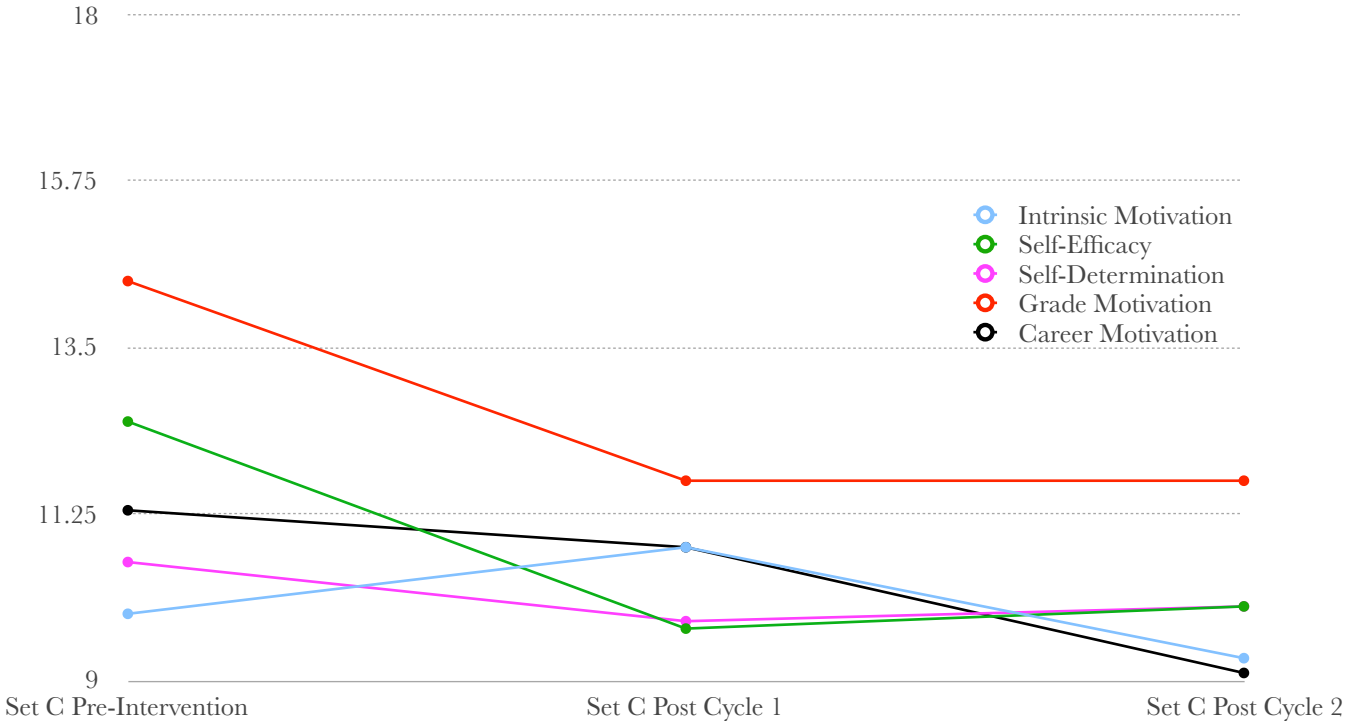


Figure 13 - Graph showing the changes in mean values of motivation for set C over the course of action research



Results for set C (figure 13) show a decrease in most categories over time. Intrinsic motivation seems to increase during cycle one and then drop during cycle 2. Self-determination and self-efficacy drop initially during cycle one and then seem to level off slightly in the second cycle. The changes seen are slight and the standard deviation (shown in figure 10) is large in each of these means. There is, however, a notable difference when a comparison is made between figures 12 and 13, these have been drawn with the same scale to allow comparison and the trend can be clearly seen to show a decrease in motivation in set C and an increase in set A.

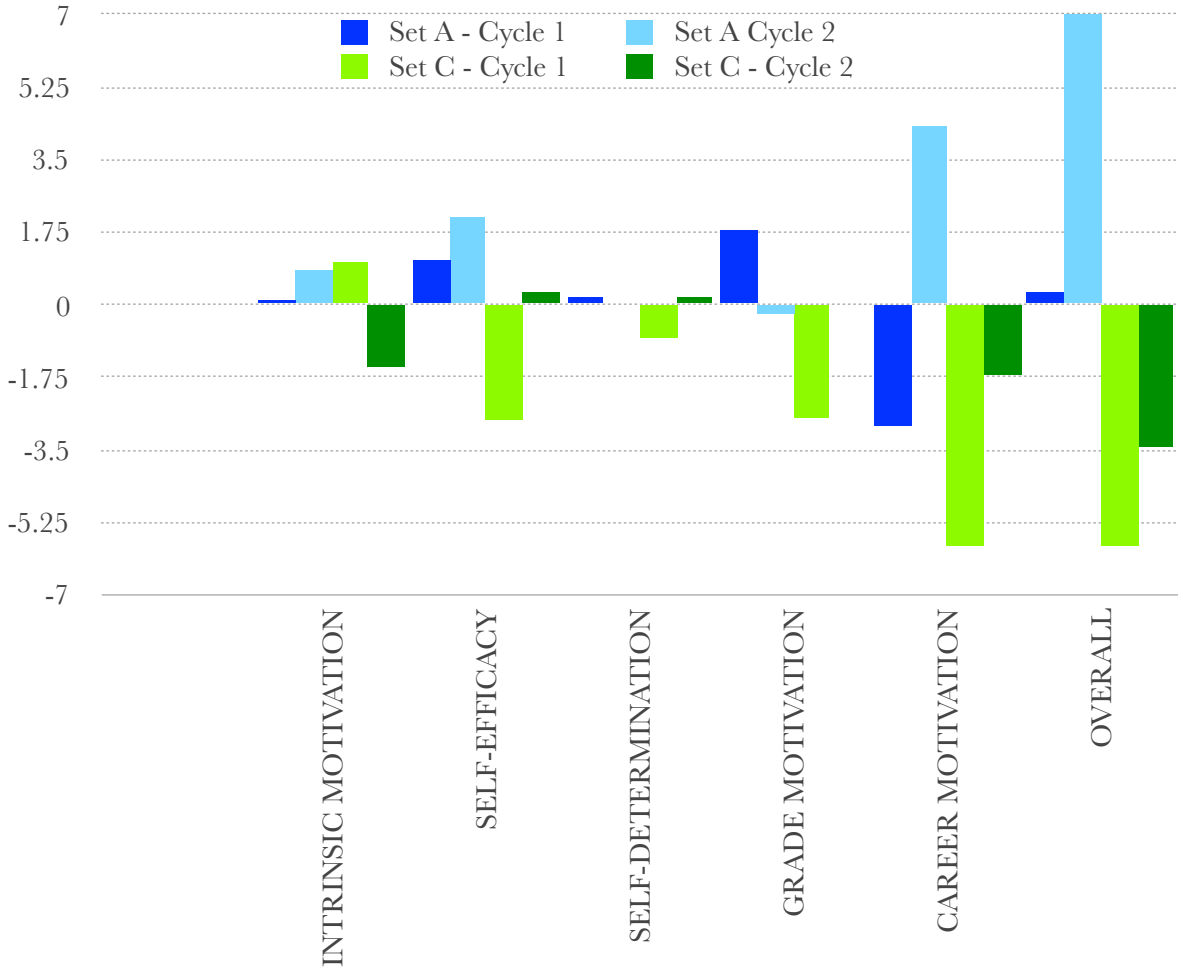
My final analysis compares changes in the means in cycle one and cycle two between the two sets. These figures with standard deviations displayed are shown in figure 14 below.

	SET A	SET A	SET C	SET C
	Cycle 1	Cycle 2	Cycle 1	Cycle 2
INTRINSIC MOTIVATION	+0.1	+0.8	+1.0	-1.5
SELF-EFFICACY	+1.1	2.1	-2.8	+0.3
SELF-DETERMINATION	+0.2	+0.0	-0.8	+0.2
GRADE MOTIVATION	+1.8	-0.2	-2.7	+0.0
CAREER MOTIVATION	-2.9	+4.3	-5.8	-1.7
OVERALL	+0.3	+7.0	-5.8	-3.4

Figure 14 - Table to show analysis of the reciprocals of the means of each motivation category after action research cycle 1 and 2.

Figure 15 below shows this analysis graphically. The negative impact of flipped learning on motivation in set C is shown with decreases in four out of the five categories after cycle one followed by quite negligible change after cycle two in all except the intrinsic and career motivation which both decrease. By contrast set A shows negligible increase in most motivational categories after cycle one and therefore only a very slightly increase in overall motivation. After cycle two the overall increase can be seen to be more marked and this is due to increases in self-efficacy, intrinsic motivation and career motivation.

Figure 15 - Graph showing the changes in motivation over research cycles for set A & C.



Again I must emphasise that the results I have collected are from a small sample size but the information from the interviews and questionnaires would seem to clearly reflect a negative impact on motivation in many of the pupils in set C and a more positive impact on those in set A. I will now return to the research literature to discuss these results further.

5. DISCUSSION

Having considered the results for the SMQII and the focus group discussions I will return to consider the research question:

What is the impact of using flipped learning homework tasks on pupil motivation?

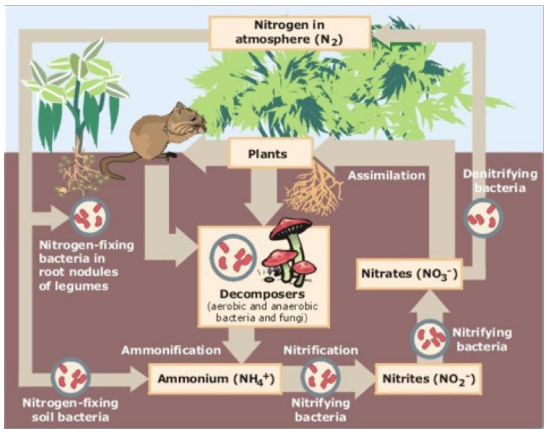
There appears to be a notable difference in motivation between sets A and C so I will consider them separately in this discussion. I will also break the research question into two parts and will first consider the responses of set A and C to flipped learning before then considering the impact of the flipped learning intervention on pupil motivation.

RESPONSE OF SET A TO FLIPPED LEARNING

The first point to make in relation to set A is that they were much more positive in their comments about the intervention, as shown in figures 5 and 6. The positive comments support research by Palmer (2005) and Lepper and Hodell (1989) which found that it is important that tasks are novel and develop curiosity. Set A engaged enthusiastically in the intervention process and were interested in trying a new method of learning, this can be considered an early indication of their motivation levels. I will explore this further when looking at the questionnaire data but it is an indication that they were already more motivated than set C as the novel task is serving to motivate regardless of the flipped learning intervention. In contrast to arriving at the lesson and expecting to be passively 'taught' it was refreshing for me that the pupils arrived at the lessons with knowledge of the topic and ready to ask questions about what they did not quite understand. They were very involved in the learning process and I will discuss this further in the next section as this will have an impact on their motivation. The process of flipped learning helped these pupils to develop self-regulated learning (SRL) which Pintrich (2004) found to be influenced by motivation. The pupils in set A were negative about the length of time that it took to complete the task, however, this showed that they were investing the time needed to watch and re-watch the material so that they could process the information and develop a good understanding. A longer study would be needed to assess whether the time spent on the task would decrease when the process became less novel (as found by Chen *et al.* 2006), but this supports Zusho,

Pintrich and Coppola's (2003) discussion of SRL which they describe as an active constructive process. The pupils in set A were showing very strong evidence of active constructivism in the way they were drawing material from other websites, text books and other sources and indicates that flipped learning is helping to develop SRL. The flipped learning process helped set A increase awareness of themselves as learners and I expect that this may have an impact on self-determination and self-efficacy; I will consider this in the next section as I review the questionnaire results. Black and Deci (2000) recognise that flipped learning helps to develop greater autonomy and this is clearly evident from my observations of set A. Although this is different to motivation, the flipped learning process has certainly developed the pupils as independent learners; they are now more confident working alone and developing their own understanding of biological concepts. In my collaborative discussions with the MOG leaders this was something which particularly appealed to colleagues. I was able to highlight the benefits that flipped learning had on the pupils in this context and highlight the skills it developed in set A pupils. I will explore this further when considering the questionnaire results as I would expect this to have impacted on self-determination motivation. Deci, Vallerand, Pelletier and Ryan (1991) highlight that this depends on competence and autonomy and set A show this to be the case.

The second point relating to flipped learning echoes with Kettle's (2013) study in which she raised concerns about the quality of the notes her pupils produced. I strongly feel that understanding the topic is more important than having an immaculate set of notes which the pupils do not understand. However, particularly in cycle one many of the pupils in set A were concerned about knowing what they should write down when constructing their notes. This was one reason for developing greater scaffolding and support in cycle two. This idea is supported by research by Meyer *et al.* (2008) which highlights the need for scaffolding to support motivation. Figure 16 below shows the simple sheet I produced to support pupils in their work on the nitrogen cycle, key words were given which gave the pupils greater direction. Figure 8 shows the result of a pupil in set A using this effectively. In order for flipped learning to be effective it must be supported by resources to aid pupils, otherwise they can become despondent. This has been a key finding for my own practice and development of resources which guide pupils through the flipped learning tasks will be a focus for next year.



Key Words
Nitrifying Bacteria, Denitrifying Bacteria, Azotobacter, Nitrosomonas, Nitrobacter, Rhizobium, Nitrogen Fixing, Decomposers, Lightning, Fertilisers.

Figure 16 - An example of scaffolding provided in cycle 2 to help pupils in making effective notes from the video on the Nitrogen cycle

Most of the negative comments from set A related to the time it took them to complete the tasks, from set C the negative comments were more wide ranging and I will discuss these later. Set A's negative comments related to the videos themselves, not the process, and the challenges they found assimilating the information. Whilst I do not want to divide them based on perceived ability, the test marks (figure 10), in the two tests taken during the intervention show a large differential. As I mentioned, even before the intervention Set A had much higher marks in a test which was sat at the start of January 2017: Set A: Mean 74% (SD14) compared to Set C: Mean 50% (SD8). This trend was then also seen in the test following the photosynthesis topic test: 64% (SD13) compared to 38% (SD18). I will revisit these figures when considering motivation as there is research to suggest that motivation affects test marks (Hong *et al.* 2015). Some other studies into flipped learning (Deslauriers, Schelew & Wiesman, 2011, Nicholas, 2014, He *et al.*, 2016) suggest that flipped learning can increase attainment. Since I did not have a control group, a comparison of this from my study is not possible. It is worth recalling that set A is the higher attaining set and their mean test mark for the pre-intervention test (figure 10) illustrates this. My point is that they seemed able to adopt new ideas and assimilate new concepts

more easily than set C. This perhaps lends support to Kettle's (2013) research in a UK secondary school in which she found that her 'best' pupils flourished when using flipped learning.

Although there were some shortcomings of the videos used, pupils in set A recognised that it is a 'new way to learn' and that it is a beneficial alternative to noting from a text book as it requires pupils to think and process the information before making notes. They were willing to adopt it as a regular homework task although they were quick to point out that if this was adopted by every subject it would take them far too long to complete. I will continue teaching this set next year and will look to continue using flipped learning with them. Petty (2006) highlights that variety is key so for my own practice I will look to adopt a period of flipped learning with other teaching sets in each academic term. This will increase the sample size and allow me to observe and record the reaction of other sets to flipped learning. To support the efficacy of the process I will support the pupils with well planned support and also ensure that notes are reviewed by me as many in set A commented that this was very reassuring.

RESPONSE OF SET C TO FLIPPED LEARNING

It is not possible to generalise for the whole of set C but it is immediately clear from figures 5 and 6 that set C were not as receptive to the flipped learning process. Chen (2016) found that pupils initially arrived unprepared and unwilling to engage in the process; I found that set C were initially quite enthusiastic about trying it but having attempted one homework were very despondent about the intervention. Photosynthesis is a challenging topic so it is perhaps understandable that this was the case but I was surprised that Set C continued to find the concept difficult even when they moved on to the ecology topic later in the term. They were frustrated when they arrived in lessons during cycle one and had not understood what the videos were trying to explain. Kettle (2013) noted similar themes with her 'weaker' A level pupils and the notes which these pupils produced were often lacking in any structure, coherence or detail. By contrast to set A they did not find that the novel experience of flipped learning was helping to motivate them. These pupils were more like those who Meyer *et al.* (2008) recognise as lacking self-efficacy and therefore these novel tasks seemed to demotivate. For my

own practice with similar sets I will be cautious in adopting flipped learning and look to ensure that I do it for short periods of time with appropriate topics.

Even though they found the process hard, it is important to note that there were positive comments from set C, when they found it hard many of the pupils started to use text books to help them and some started also to use other videos which they looked up on the internet. I found this encouraging as highlighted by one male pupil in set C who summarised it as follows:

"Encourages a student to be independent….I feel that this is a good idea and could greatly benefit pupils as it will get them more engaged with their subject however the video is too fast for them to gather information."

Another pupil expressed the following views:

"I am not carrying on biology, however, if I was, I think I would be confident as the preps are efficient at helping me learn" Set C Female

The use of the word confident directly relates to self-efficacy as this pupil clearly feels that the process of flipped learning would help support her in her learning and this will in turn lift her self-efficacy. Hong *et al.* (2015) showed that higher levels of self-efficacy increased homework performance and Bandura and Locke (2003) also highlight the importance of self-efficacy. The above comments highlight that although the results from set C may not seem overwhelmingly supportive of flipped learning, there are positive impacts on learning. It is also worth noting that after cycle two the number of negative and positive comments were equal marking a decrease in negative comments with repeated exposure to the technique. As with set A the importance of structure and scaffolding was one which came through very strongly. Upon reflection the frustrations which set C experience may have been much less prevalent had they had greater scaffolding and structure in place from the start. When this structure was given the notes the pupils produced still lacked detail and none of the pupils used the help sheets given to construct their notes.

Others in set C were less positive in their responses, the most blunt of whom summarised the intervention as follows:

"Flip learning is a waste of time" Set C Male

This final statement clearly highlights that this pupil has not seen value in the flipped learning process and this is evident in the questionnaire data. I have discussed some literature which relates to differences in homework preference relating to gender. The sample size for my study is too small to make valid gender comparisons. In set C there were only two girls, both of whom engaged well in the process and the comments made by one of them are shown and discussed above. Given that studies (Hong & Milgram, 2000, Iflazoglu & Hong, 2012) have shown boys prefer kinaesthetic tasks, I anticipated that the nature of flipped learning would appeal to the boys as it is more active. This was not the case and therefore it would seem to support the idea that motivation is so multi-faceted that it is hard to predict preferences and equally hard to generalise about gender.

On reflection, the timing of this intervention was not ideal because, in my experience, the photosynthesis topic is the most challenging in the year 12 scheme of work. This meant that pupils were introduced to the process of flipped learning on a difficult topic which made it harder for them to view it positively. This gave rise to negative comments from pupils who suggested that that they did not think that it should be used for complicated topics, and was put by one pupil in his closing comments as:

"Flip Learning is not very efficient with difficult topics" Set C Male

It is harder to generalise the feedback from set C. It is a small set with only seven pupils (5 boys, 2 girls) interestingly only two pupils intend on continuing biology into year 13, this should be considered when reviewing the questionnaire data in the next section. I do not think this is a response to the flipped learning intervention but more a reflection that these pupils found the year 12 biology course very challenging. In many cases pupils decided during the period of intervention that they would be ceasing biology and this decision may have impacted negatively on their motivation. When pupils are already demotivated the flipped learning intervention does not appear to increase their motivation and I would be cautious about adopting such a strategy at this stage of the year in the future. I have

discussed this with colleagues ahead of next year; the introduction of flipped learning early in the first term of year 12 may be more powerful as pupils are more committed to the subject.

In summary, the interview data shows that the two sets had differing responses to flipped learning. Set A were willing to engage in the a new style of learning whereas many in set C were reluctant to do so. I will now move on to consider if these trends are also reflected in the SMQII results.

IMPACT ON MOTIVATION IN SET A

Having considered the focus group interview data I will now move onto explicitly consider the evidence from the SMQII data and whether the flipped learning intervention has increased motivation.

Data from the SMQII is shown in figures 8, 9 and 10. In general terms the mean levels of motivation in set A increased during the period of flipped learning; the increase being most pronounced in the second cycle of action research. The first cycle showed only a very slight increase from 60.0 to 60.4 and given the large standard deviation is unlikely to be showing change of any significance. The second cycle corresponds to the ecology stage of the scheme of work when the pupils were provided with the supportive scaffolding as shown in figure 16. Given the comments from the focus group interviews, I was surprised to see that the questionnaire showed there is very little increase in self-determination as a result of the intervention. Black and Deci (2000) found that in chemistry lessons pupils with higher self-determination were likely to perform better. I expected the active-constructive nature of flipped learning to develop self-determination. Pelletier and Ryan (1991) state that self-determination relies on autonomy which I expected flipped learning to help to foster. Deci *et al.* (1991) also found that pupil choice and responsibility would enable self-determination which further highlights why I expected flipped learning to increase the levels of self-determination and active motivation. There is evidence that the autonomy and SRL which flipped learning engenders did increase motivation but not the self-determination element. The increase is however, seen in self-efficacy (10.9 SD2.5 to 14.1 SD3.8), which indicates that the pupils are developing belief in their own ability through the process and this is further supported by comments by some pupils in the focus

group who commented that because it is harder to rush through the task more time is invested. Furthermore, pupils in set A admitted that they don't read notes they are given; in making their own notes the information is easier to understand. This tallies with figure 2 which shows that flipped learning falls under the audio-visual (20%) segment of the learning pyramid (Chen, 2016) and I suggest it qualifies as more active participatory and therefore upwards of 50%. Self-efficacy was found by Hong *et al.* (2015) to reduce worry and also increase homework achievement and motivation. Palmer (2005) also argues that involvement in the learning process will aid motivation. The higher levels of self-efficacy would indicate that this has contributed to the effect of the intervention in set A. The SMQII will be used next year to assess the levels of self-efficacy ahead of an introduction of flipped learning. The results can be used to direct me in recognising which sets will be most receptive to flipped learning.

Set A also show an increase in extrinsic motivation (goal orientated behaviour) in the form of career motivation. Interestingly this decreased during cycle one and then increased dramatically in cycle two. Deci, Koestler and Ryan (2001) and Black (2003) have questioned whether extrinsic motivation, which is often developed through rewards given in schools, leads to greater learning. It is thought to increase surface motivation but not better understanding. The grade motivation increases very slightly during the two cycles (from 15.7 to 17.3) but it is not clear if this is reflective of a trend and I also recognise that this is influenced by other factors which could be serving to increase grade motivation as they move through year 12.

As I explained in my literature review, studies into the effect of flipped learning on *motivation* are not common. This said, my results for set A agree with Jeong (2015) and Jeong, Bae and So (2015) from their Korean studies in finding that flipped learning did serve to increase motivation. For my own practise this is further evidence that it has helped developed autonomy in these pupils and is a process which I will look to adopt next year. The increase in the second cycle could be an indication that it is especially powerful when used with a less testing topic such as ecology and I will look to highlight similar topics in the department scheme of work next year so that colleagues can implement flipped learning powerfully.

IMPACT ON MOTIVATION IN SET C

The SMQII results for Set C are less supportive of the research question as over the period of the intervention the motivation levels have decreased with overall scores showing a decrease of -5.8 in the first cycle and -3.4 in the second cycle (figure 11 and 13). Figure 15 shows this trend and highlights the motivational areas in which the decreases are greatest. The greatest changes in motivation are seen in the first cycle during the photosynthesis topic. Although overall motivation does decrease in the second cycle of action research, this is less pronounced. It would seem that for set C flipped learning has not served to increase their motivation, however, given that motivation is so multifaceted it is hard to know if other factors have caused this decrease. Most notably a decision to drop biology (after year 12) had a strong influence on many pupil's motivation during this period. The focus groups' perception that the photosynthesis topic was too hard for flipped learning fed into changes for the second action cycle; these changes did not have the desired effect and lead me to acknowledge that for some sets flipped learning may be demotivating. I am therefore hesitant about suggesting universal introduction of flipped learning next year. The pupils in set C seemed to be focusing on their own weaknesses and ruminating on what they found hard in the same way that Bandura (1982) describes. As the ALIS data shows (figure 1) the mean GCSE points average for Set C is nearly a grade less than set A: 6.65 compared to 7.51. Interestingly though, their ALIS test score, based on computer aptitude tests completed in September, is slightly higher for Set C: 91.86 compared to 90.36. It is important also to note that pupils at school x typically take four A levels but most will choose to drop one of these subjects after year 12. In set C motivation levels towards biology may have decreased during the two cycles of action research as some pupils decided that they will be dropping biology at the end of the academic year. In set C this will be the case for 5 out of the 7 pupils. One of these pupils in particularly scored only 13 on the overall SMQII score which will have affected the overall set mean. In fact removing the five pupils who will be stopping Biology from the calculation takes the mean for Set C up to 73. This illustrates that there are many more factors involved in contributed to motivation than just the flipped learning intervention and that even within set C there are some pupils for whom motivation has increased. In further collaboration I have discussed with the director of teaching and learning the impact of taking four a level subjects has on the motivation of these pupils. In discussions

over whether pupils should take three or four subjects this gives powerful evidence that for many pupils three A levels would be more suitable.

The results for set C do not seem to show the positive impacts of flipped learning which Bergmann and Sams (2012) and Khan (2011) extol. As a group they highlighted in their focus group comments that they found it challenging and this is further reflected by the questionnaire data. Deci and Ryan (2000) found that involving pupils in the learning process and making sure tasks are engaging will help increase motivation. Set C's results do not support this study but are in agreement with the findings of He *et al.* (2016) who found no increase in motivation when flipped learning was used in undergraduate chemistry lessons.

I have discussed some research into gender differences with regards to focus group comments, Hong and Milgram (2000) suggests that in terms of homework practices there are more similarities than differences. By contrast other research by Harris, Nixon, & Rudduck (1993) and Honigsfeld & Dunn (2003) suggests that in general girls have a more positive attitude to homework than boys. Given the very small nature of the sample size and a girl:boy ratio of 7:4 in set A and 2:5 in set C one must be very cautious to draw to many conclusions from my research. In the focus groups the balance of comments from girls and boys was even and no observable difference was seen.

When the means of the overall motivation scores were compared the results showed increasing differences throughout the period of action research. The values for Set A were similar at the pre-intervention stage: boys 63.5; girls 64.3. Then after the first cycle: boys 65.3; Girls 63.3. At the end of the second phase the girls' motivation had dropped to 67.9 compared to the boys which was 84.5. The only area which did not drop in this period for the girls was the grade motivation which remained similar to that of the boys. Set C showed a similar trend with the girls dropping to 32.0 at the end of cycle two compared to the boys which was at 56.4. This supports Hong and Milgram's (2000) view that boys prefer the flipped learning homework task as it a more active and involved process which requires higher self-efficacy. It could be suggested that boys are more self-efficacious and this supports them better through the challenges of flipped learning.

Set A and C therefore show notable differences in their responses to the intervention. This presents challenges when considering how the study will feed into my own practice. The results show that it would not be sensible to adopt the same strategies for all teaching sets. It is important to recognise that differentiation is important in delivery of flipped learning and whilst some pupils flourish with little support or scaffolding, most will require both support in lessons and scaffolding for their homework. Another important consideration is the need to check the notes pupils have made. As illustrated by the set C pupil who said he loved flipped learning because you can get away without doing it, if the notes are not collected in, and valid feedback given, then pupils can feel that it is not important to complete the homework.

In the conclusion I will summarise my findings and go into further detail about limitations of the study and how these could be reduced and importantly how the study will inform my practice, and that of my colleagues.

6. CONCLUSION

The flipped learning intervention I have carried out in the secondary school in which I work was aimed at increasing levels of motivation. Motivation is multi-faceted (Smith and Spurling, 2001, Smith *et al.* 2005) and, in year 12 pupils, hugely complex but I will finish by summarising my findings before looking at how this study will inform my practice.

In the intervention of two cycles of action research, involving delivery of flipped learning homework tasks over the course of the term, different results were seen with different teaching sets. As in Kettle's research (2013) I found that the higher attaining set embraced flipped learning more readily. The SMQII (Glynn *et al.* 2011) results showed an overall increase in motivation for this set and in particular they showed increased levels of self-efficacy after both research cycles. This supports the findings from research into flipped learning and motivation conducted by Jeong (2015) and Jeong, Bae and So (2015). I believe it also shows that flipped learning helps to develop the pupils as independent learners as Black and Deci (2000) suggest. This independence was not fostered during the intervention in the lower attaining set. Many of the pupils in this set struggled to construct informative notes from the videos and as a result were demotivated. The SMQII results for set C showed this and are in agreement with Kettle's (2013) research where she found a similar reaction amongst some pupils. In both sets some pupils stated that they did not enjoy the process and this is similar to He et al. (2016) findings of polarised opinions.

There are limitations to the study which should be noted. The sample size was just two sets comprising of 18 pupils in total. For this reason it has not been possible to use any statistical analysis but means of the data have been compared. The other main limitation are the two measures of motivation I have used. It is widely recognised that the measurement of motivation is complex and for that reason I used the SMQII because it has been validated by research (Glynn *et al.*, 2011). Although this justifies the use of the questionnaire, the categorisation and assessment of the five different motivational criteria based on just five questions is a limitation. The pupils found some of the

questions hard to judge, such as 'completing biology makes my life more meaningful', and this will affect the results. I was limited in that the study was completed with my own teaching sets and I am aware that the opinions expressed in focus groups could be affected by my presence in the interview. I did not measure motivation in the lessons themselves. Another limitation is that the flipped learning is heavily dependent on the quality of videos used. The Khan academy was selected having looked at the range of resources available on line. Several of the pupils found elements of Khan's presentation hard to follow. Having looked for other videos online, there would be merit in making departmental resources to support pupils better. I would also consider developing the questionnaire or using other methods to measure motivation during the intervention in addition to measuring motivation during lessons in which pupils are working through problems and questions. I could use lesson observations of colleagues in order to develop a way of measuring how motivated pupils are when working in lesson time. Nicholas (2014) has already developed a lesson observation framework used in school x and I will observe some flipped lessons using this framework next year.

The results from the focus groups and questionnaires varied considerably between the two sets but both sets unanimously requested greater structure in the task after the first cycle. For flipped learning to be effective tasks need to be well-planned and the pupils must be supported appropriately. I have discussed the additional materials provided to support the pupils when watching the videos were well used by some pupils. Dissemination of these resources throughout the department and to pupils via the VLE, Firefly, which is used at school x would be straightforward. Pupil concerns about video relevance could be addressed by providing topic specific checklists using the same distribution method. Support sheets (figure 16) gave the pupils some useful information but pupils commented that a series of questions to answer alongside the video would also be of use. These will be developed next year for use in the biology department alongside specific videos. I have discussed the principles and method of introducing flipped learning and suggested that it is trialled next year in the scheme of work following a period of collaborative planning. To encourage autonomy for all pupils the resources outlined above should be provided and the points made herein considered to support the initiative.

School x is currently reviewing the process and setting of homework. From a survey carried out in 2017 by all pupils in school x, 91% of pupils believe they need to use the internet to assist with homework; by contrast, only 19% of teachers believe the homework they set requires the use of the internet. In my collaboration with the MOG leaders I presented the idea of flipped learning and it was positively received. The teachers involved in the meeting felt it would help pupils to use the internet productively. The main concern over much of the use of the internet at school x is that many pupils to go to the internet to 'find the answers' and not for genuine research or thirst for knowledge. This therefore returns to my former point, that in order for flipped learning to be truly effective it must be directed: not only by a link to the video clip, but also with rigorous and structured resources. I will use an INSET day next term to present the findings herein to the teaching staff and encourage the considered use flipped learning to promote motivation. Developing the flipped learning process has been valuable for the pupils and when implemented effectively flipped learning can serve to motivate pupils. I started the process curious as to how to adapt the homework I set pupils to help use their time more positively. I have explored flipped learning and found that for many pupils it develops greater autonomy and can serve to motivate. I will alter my own practice next year and use a period of time each term to employ flipped learning teaching. The topics will be careful selected, in collaboration with colleagues, and supporting resources provided which others can use to aid effective delivery of flipped learning which I hope will develop the pupils as more independent and effective learners and in doing so increase their motivation.

REFERENCES

Atkinson, J. (1964). *An Introduction to Motivation*. Princeton, NJ: Van Nostrand.

Baepler, P., Walker, J.D. & Driessen, M. (2014). It's not about seat time: Blending, flipping, and efficiency in active learning classrooms. *Computer & Education*, **78**, 227-236.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist*, **37**, 122-148.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory.* Englewood Cliffs, NJ: Prentice-Hall. Bandura,

Bandura, A., & Locke, E. (2003). Negative self-efficacy and goal effects revisited. *Journal of Applied Psychology,* **88**, 87–99.

Bergmann, J. & Sams, A. (2012). *Flip Your Classroom: Reach Every Student in Every Class Every Day.* Alexandria, Va.: The Association for Supervision and Curriculum Development.

Black, A.E., & Deci, E.L. (2000). The effects of instructors' autonomy support and students' autonomous motivation on learning organic chemistry: A self-determination theory perspective. *Science Education*, **84**:6, 740–756.

Bryan, R.R., Glynn, S.M., & Kittleson, J.M. (2011). Motivation, achievement, and advanced placement intent of high school students learning science. *Science Education*, **95***:*6, 1049–1065.

BERA (2011). *Ethical Guidelines for Educational Research*. British Educational Research Association. ISBN: 978-0-946671-32-8

Cameron, J. (2001). Negative Effects of Reward on Intrinsic Motivation - A Limited Phenomenon: Comment on Deci, Koestner, and Ryan (2001). *Review of Education Research*, **71**:1, 29-42.

Chen, L. (2016). Impacts of Flipped Classroom in High School Health Education. *Journal of Educational Technology Systems*, **44**: 4, 411-420.

Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in education.* London; New York: Routledge.

Cooper, H. (1989). Synthesis of Research on Homework. *Effective Schools Research Abstracts*, **4**, 85-91.

Cooper, H. (1992). "Homework." In Encyclopaedia of education. 2nd ed, edited by J. Guthrie. New York: Macmillan.

Cooper, H. (2006). Duke Study: Homework Helps Students Succeed in School, As Long as There Isn't Too Much. *Duke Today*, 7 March. [Online] https://today.duke.edu/2006/03/homework.html [Accessed 24 March, 2016]

Cooper, H. (2007). *The Battle Over Homework: Common Ground for Administrators, Teachers and Parents.* Corwin Press.

Cooper, H. (1999). Homework research and policy: A review of the literature. *Center for Applied Research and Educational Improvement* 2, no. 2: 1–9. Available from: <http://www.hisparks.com/MathHelpers/Homework_Research_and_Policy.pdf> [Accessed 24 March, 2016]

Cooper, H., Robinson, J.C. & Patall, E.A. (2006). Does Homework Improve Academic Achievement? A Synthesis of Research, 1987-2003. *American Educational Research Association Review of Educational Research,* **76**:1, 1-62.

Corno, L. (2000). Looking at Homework Differently. *The Elementary School Journal*, **100**:5, 529-548.

Coutts, P. (2005). Meanings of Homework and Implications for Practice. *Theory into Practice*, **43**:3, 182-188.

Deci, E.L., Koestner, R., & Ryan, R.M. (2001). Extrinsic rewards and intrinsic motivation in education: Reconsidered once again. *Review of Educational Research*, **71**, 1–27.

Deci, E.L. & Ryan, R.M. (1985). Intrinsic Motivation and Self-Determination in Human Behavior. New York: Plenum Press.

Deci, E. L., & Ryan, R. M. (1991). A motivational approach to self: Integration in personality. In R. Dienstbier (Ed.), *Nebraska symposium on motivation*: Vol. 38, Perspectives on motivation, 237-288. Lincoln: University of Nebraska Press.

Deci, E.L., & Ryan, R.M. (2002). *Handbook of Self-Determination Research.* The University of Rochester Press.

Deci, E.L., Vallerand, R.J., Pelletier, L.G., Ryan, R.M. (1991). Motivation and Education: The Self-Determination Perspective. *Educational Psychologist,* **26**:3-4, 325-346.

Deslauriers, L., Schelew, E., & Wieman, C. (2011). Improved learning in a large-enrollment physics class. *Science*, **332**:6031, 862-864. Available from: <http://science.sciencemag.org/content/332/6031/862> [Accessed 2 August, 2017]

Dweck, C.S. (1986). Motivational processes affecting learning. *American Psychologist*, **41**, 1040-8.

Evans, D. (2012). Lessons turned upside down. *Times Education Supplement* 26: 2258. Available from: <https://www.tes.com/news/tes-archive/tes-publication/turning-lessons-upside-down> [Accessed 3 August, 2017]

Farrell, A. & Danby, S. (2015). How does homework 'work' for young children? Children's accounts of homework in their everyday lives. *British Journal of Sociology of Education* **36**:2 250–269. Available from: <http://dx.doi.org/10.1080/01425692.2013.814532> [Accessed 2 August, 2017]

Galloway, D., Rogers, C., Armstrong, D., Leo, E. with Jackson, C. (2004). 'Ways of understanding motivation', in H. Daniels and A. Edwards (eds.) *The Routledge Falmer Reader in Psychology of Education*, London: Routledge Falmer.

Gill, B.P., & Schlossman, S.L. (2004). Villain or Savior? The American Discourse on Homework, 1850-2003. *Theory into Practice* **43**:3, 174-181.

Glynn, S.M., Brickman, P., Armstrong, N., & Taasoobshiazi, G. (2011). Science Motivation Questionnaire II: Validation with Science Majors and conscience majors. *Journal of Research in Science Teaching* **48**:10, 1159-1176.

Glynn, S.M. & Koballa, T.R. (2006). Motivation to learn college science. In J.J. Mintzes & W.H. Leonard (Eds.) *Handbook of College Science Teaching*. Arlington VA: National Science Teacher Association Press.

Glynn, S.M., Taasoobshirazi, G., & Brickman, P. (2007). Nonscience majors learning science: A theoretical model of motivation. *Journal of Research in Science Teaching,* **44**, 1088–1107.

Glynn, S.M., Taasoobshirazi, G., & Brickman, P. (2009). Science motivation questionnaire: Construct validation with nonscience majors. *Journal of Research in Science Teaching*, **46**:2, 127–146.

Harris, S., Nixon, J., & Rudduck, J. (1993). School Work, Homework and Gender, *Gender and Education*, **5**:1, 3-15. Available from: <http://dx.doi.org/10.1080/0954025930050101> [Accessed 2 August, 2017]

Hattie, J. (2012). *Visible Learning for Teachers: Maximizing Impact on Learning.* London: Routledge

He, W., Holton, A., Farkas, G. & Warschauer, M. (2016). The effects of flipped instruction on out-of-class study time, exam performance, and student perceptions, *Learning and Instruction*, **45**, 61-71.

Hong, E., Mason, E., Peng, Y. & Lee, N. (2015). Effects of homework motivation and worry anxiety on homework achievement in Mathematics and English. *Educational Research and Evaluation*, **21**:7-8, 491-514.

Hong, E. & Milgram, R.M. (2000). Preferred and actual homework style: a cross-cultural examination, *Educational Research*, **41**:3, 251-265. Available from: <DOI: 10.1080/0013188990410302> [Accessed 2 August, 2017]

Honigsfeld, A., & Dunn, R. (2003). High School Male and Female Learning-Style Similarities and Differences in Diverse Nations, *Journal of Educational Research*, **96**:4, 195-206. Available from: <http://www.jstor.org/stable/27542433> [Accessed 2 August, 2017]

Hoover-Dempsey, K.V., & Sandler, H.M. (1995). Parental involvement in children's education: Why does it make a difference? *Teachers College Record*, **97**, 310-331.

Hull, C.L. (1943). *Principles of behavior: an introduction to behavior theory*, New York; London: Appleton-Century.

Hutchinson, K. (2011). Homework through the Eyes of Children: what does the visual ethnography invite us to see? *European Educational Research Journal*, **10**:4, 545-558.

İflazoğlu, A., & Hong, E. (2012). Relationships of Homework Motivation and Preferences to Homework Achievement and Attitudes in Turkish Students, *Journal of Research in Childhood Education*, **26**:1, 57-72.

Jeong, M. (2015). A Case Study of Flipped Learning in Calculus of one Variable on Motivation and Active Learning. *Research in Mathematical Education*, **19**:4, 211-227.

Jeong, J-H., Bae, J. & So K.H. (2015). The Effect of Flipped Learning of Elementary Science Class on Learning Motivation and Academic Achievement of Elementary Students. *Biology Education*, **43**:4, 333-343.

Kahn, S. (2011). Let's use video to reinvent education. TED Talks [Online]Available from: <https://www.ted.com/talks/salman_khan_let_s_use_video_to_reinvent_education> [Accessed 11 April 2017].

Kettle, M. (2013). Flipped Physics, *Physics Education*, **48**:5, 593-596.

Kohn, A. (1993). *Punished by Rewards: The Trouble with Gold Stars, Incentive Plans, As, Praise and Other Bribes.* Boston: Houghton Mifflin and Co.

Kidwell, V. (2004). *Homework*. London: Continuum.

Leone, C.M., & Richards, M.H. (1989). Classwork and homework in early adolescence: The ecology of achievement. *Journal of Youth and Adolescence*, **18**:6, 531–548.

Lepper, M. R., & Hodell, M. (1989). Intrinsic motivation in the classroom. In C. Ames & R. Ames (Eds.), *Research on motivation in education* **3**, 73–105. San Diego, CA: Academic Press.

Lyon Taylor, J.J. (2016). A research study reviewing the purpose of homework? Post graduate Diploma in Learning and Teaching dissertation, University of Oxford.

Martin, A.J. (2002). Motivation and Academic Resilience: Developing a Model for Student Enhancement. *Australian Journal of Education*, **46**:1, 34-49.

Martin, A.J. (2007). Examining a multidimensional model of student motivation and engagement using a construct validation approach. *British Journal of Educational Psychology*, **77**:2, 413–440.

Mecce, J.L., Glienke, B.B. & Burg, S. (2006). Gender and Motivation, *Journal of School Psychology*, **44**:5, 351-373.

Mega, C., Ronconi, L., De Beni, R. (2013). What Makes a Good Student? How Emotion, Self-Regulated Learning, and Motivation Contribute to Academic Achievement. *Journal of Education Psychology*, **106**:1, 121-131.

Meyer, B., Haywood, N., Sachdev, D. & Faraday, S. (2008). *What is independent learning and what are the benefits for students.* London: Department for Children, Schools and Families Research Report.

Nicholas, W.D.L. (2014). Flipping Chemistry lessons: an investigation into pupil and teacher perceptions of the flipped classroom. MSc Research and Development Project, University of Oxford.

Palmer, D. (2005). A Motivational View of Constructivist-informed Teaching, International *Journal of Science Education*, **27**:15, 1853-1881.

Pajares, F. (2002). Gender and perceived self-efficacy in self-regulated learning. *Theory into Practice*, **41**:2, 116–125.

Paschal, R.R., Weinstein, T., & Walberg, H.J. (1984). The Effects of Homework on Learning: A Quantitative Synthesis. *The Journal of Educational Research*, **78**:2, 97-104.

Patton, G. (2013). School bans homework to give pupils more 'family time'. *The Daily Telegraph*. 5 June. [Online] Available from: <http://www.telegraph.co.uk/education/educationnews/10101361/School-bans-homework-to-give-pupils-more-family-time.html> [Accessed 24 March 2015]

Pells, R. (2016). Secondary schools bans homework to give teachers time to improve lessons. The independent. 28 September. [Online] Available from <http://www.independent.co.uk/news/education/education-news/secondary-school-philip-morant-college-catherine-hutley-bans-homework-time-improve-lessons-a7334401.html> [Accessed 18 October 2016]

Petty, G. (2006). *Evidence Based Teaching: a practical approach.* Cheltenham: Nelson Thornes.

Pintrich, P.R. (2004). A Conceptual Framework for Assessing Motivation and Self-Regulated Learning in College Students, *Educational Psychology Review*,**16**:4, 385-407.

Pintrich, P.R., & Schunk, D.H. (1996). *Motivation in education: Theory, research and applications.* Englewood Cliffs, NJ: Prentice Hall.

Plenty, S., & Heubeck, B.G. (2011). Mathematics motivation and engagement: an independent evaluation of a complex model with Australian rural high school students. *Educational Research and Evaluation*, **17**:4 283-299.

Ryan, R.M. (2012). *The Oxford Handbook of Human Motivation.* Oxford: Oxford University Press.

Ryan, M.D., & Reid, S.A. (2016) Impact of the Flipped Classroom on Student Performance and Retention: A Parallel Controlled Study in General Chemistry. *Journal of Chemical Education*, **93**, 13-23.

Schunk, D.H., Mecce, J.L. & Pintrich, P.R. (2014). *Motivation in Education: Theory, Research, and Applications, 4th Edition.* London: Pearson.

Schumm, M.F., & Bogner, F.B. (2016). Measuring adolescent science motivation. *International Journal of Science Education*, **38:**3, 434-449.

Sharp, C., Keys, W., & Benefield, P. (2001). *Homework: A Review of Recent Research*, Slough: NFER.

Skinner, B.F. (1953). *Science and Human Behavior*. New York: Macmillan.

Smith, C., Dakers, J., Dow, W., Head, G., Sutherland, M. &, Irwin, R. (2005). A systematic review of what pupils, aged 11–16, believe impacts on their motivation to learn in the classroom. In:

Research Evidence in Education Library. London: EPPI-Centre, Social Science Research Unit, Institute of Education, University of London.

Smith, J., & Spurling, A. (2001). *Understanding Motivation for Lifelong Learning.* London: Campaign for Learning.

Stern, L.J. (1997). *Homework and Study Support: A guide for teachers and parents.* London: David Fulton Publishers.

Stern, L.J. (2006). *Getting the buggers to do their homework.* London: Continuum.

Strandberg, M. (2013). Homework – is there a connection with classroom assessment? A review from Sweden, *Educational Research*, **55**:4, 325-346, DOI: 10.1080/00131881.2013.844936

Tarras, M. (2001). The use of tutor feedback and student self-assessment in summative assessment task: Towards transparency for students and tutors. *Assessment & Evaluation in Higher Education,* **26**:6, 605-614.

Torrance, H., & Coultas, J. (2004). *Do summative assessment and testing have a positive or negative effect on post-16 learners' motivation for learning their learning and skills sector?* London: Learning and Skills Research Centre.

Touchton, M. (2015). Flipping the Classroom and Student Performance in Advanced Statistics: Evidence from a Quasi-Experiment, *Journal of Political Science Education*, **11**:1, 28-44. Available from <DOI: 10.1080/15512169.2014.985105> [Accessed 2 August, 2017]

Warton, P.M. (2001) The Forgotten Voices in Homework: Views of Students, *Educational Psychologist*, **36**:3, 155-165.

Weiner, B. (1986). *An attributional Theory of Motivation and Emotion.* New York: Springer-Verlag.

Weiner, B. (1992). *Human motivation: metaphors, theories and research.* London: Sage.

White, R. W. (1959). Motivation reconsidered: The concept of competence. Psychological Review, **66**:5, 297–333.

Wigfield, A., Eccles, J S., Schiefele, U., Roeser, R W., Davis-Kean, P., (2006). The development of achievement motivation. In: W. Damon & R. M. Lerner, eds. *Handbook of child psychology*. 6th ed. Hoboken(N.J): Wiley.

Yasemin, T., Semra, S-V., & Ceren, O. (2014). A study of science teachers' homework practices. *Research in Education*, **91**, 45-64.

Xu, J. & Yuan, R. (2003). Doing Homework: Listening to students', parents' and teachers' voices in one urban middle school community. *School Community Journal*, **13**:2, 25-44.

Xu, J. (2005). Purposes for Doing Homework Reported by Middle and High School Students. *The Journal of Educational Research*, **99**:1, 46-55.

Zusho, A., Pintrich, P. R., & Coppola, B. (2003). Skill and will: The role of motivation and cognition in the learning of college chemistry. *International Journal of Science Education*, **25**, 1081–1094.

APPENDIX 1

SMQII Questionnaire

Prep Questionnaire

Adapted from SCIENCE MOTIVATION QUESTIONNAIRE II (SMQ-II) by JJLT

In order to better understand what you think and how you feel about your biology prep, please respond with a tick to each of the following statements from the perspective of "When I am in a biology lesson/prep time..."

Statements	Never 0	Rarely 1	Sometimes 2	Often 3	Always 4
01. The biology I learn in prep is relevant to my life.					
02. I like to do better than other students on biology preps.					
03. Doing biology prep is interesting.					
04. Getting a good grade in biology prep is important to me.					
05. I put enough effort into biology prep.					
06. I use strategies to learn biology well.					
07. Learning biology will help me get a good job.					
08. It is important that I get an "A" in biology prep.					
09. I am confident I will do well on biology tests.					
10. Knowing biology will give me a career advantage.					
11. I spend a lot of time completing biology prep.					
12. Completing biology prep makes my life more meaningful.					
13. Understanding biology will benefit me in my career.					
14. I am confident I will do well on biology labs and projects.					
15. I believe I can master biology knowledge and skills.					
16. I prepare well for biology preps and tests.					
17. I am curious about discoveries in biology.					
18. I believe I can earn a grade of "A" in biology.					
19. I enjoy doing biology prep.					
20. I think about the grade I will get in biology preps.					
21. I am sure I can understand biology through prep.					
22. I study hard to learn biology.					
23. My career will involve biology.					
24. Scoring well in biology preps and tests matters to me.					
25. I will use biology problem-solving skills in my career.					

Note. The SMQ-II is copyrighted and registered. Go to http://www.coe.uga.edu/smq/ for permission and directions to use it and its discipline-specific versions such as the Biology Motivation Questionnaire II (BMQ- II), Chemistry Motivation Questionnaire II (CMQ-II), and Physics Motivation Questionnaire II (PMQ-II) in which the words biology, chemistry, and physics are respectively substituted for the word science. Versions in other languages are also available.

APPENDIX 2

Consent letter to Headmaster

UNIVERSITY OF OXFORD
DEPARTMENT OF EDUCATION

15 Norham Gardens, Oxford OX2 6PY
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general.enquiries@education.ox.ac.uk www.education.ox.ac.uk

Director Professor Jo-Anne Baird

[redacted]

26th October, 2016

Dear [redacted]

I am writing to enquire about conducting research in school this academic year. As you know, I am studying for the Master's in Learning and Teaching at Oxford University, supervised by [redacted] In my final research project "An investigation into the impact of homework tasks on pupil motivation in secondary science education". I will explore the different tasks we set for preps and how they impact the pupils.

The research will take place with my two Lower Sixth Biology sets. I will investigate the nature of the tasks set for prep and see if these could be altered in any way to help motivate the pupils. I have already discussed this with [redacted] as my MOG group leader and I will collaborate with my MOG group on this.

By participating in the research, the school would be contributing to a project that will hopefully develop our understanding of homework. It is excellent that it also fits with the topic of discussion within MOG groups for the year.

I hope to conduct this research between mid November and March. I would interview/audio-record students in discussion groups and also conduct an on-line questionnaire for them.

Oxford University has strict ethical procedures on conducting ethical research, consistent with current British Educational Research Association guidelines. As practitioner research however, the University recognises that schools have the highest ethical standards in any event. Therefore only your formal consent as headteacher is necessary, and not that of individual parents or staff. However, throughout the research, students and other teachers will be able to refuse to participate in any research activities at any time.

All participants, including students, teacher and the school, would be made anonymous in all research reports. The data collected would be kept strictly confidential, available only to my supervisor [redacted] er.education.ox.ac.uk) and me, and only used for academic purposes. It will be kept for as long as it has academic value.

If you feel you would like to take part in the study, or need more information about what is involved, please contact me or my supervisor. Further, if you have any questions about this ethics process at any time, please contact the chair of the department's research ethics committee, though: research.office@education.ox.ac.uk

I look forward to hearing from you.

Yours sincerely,

[redacted]